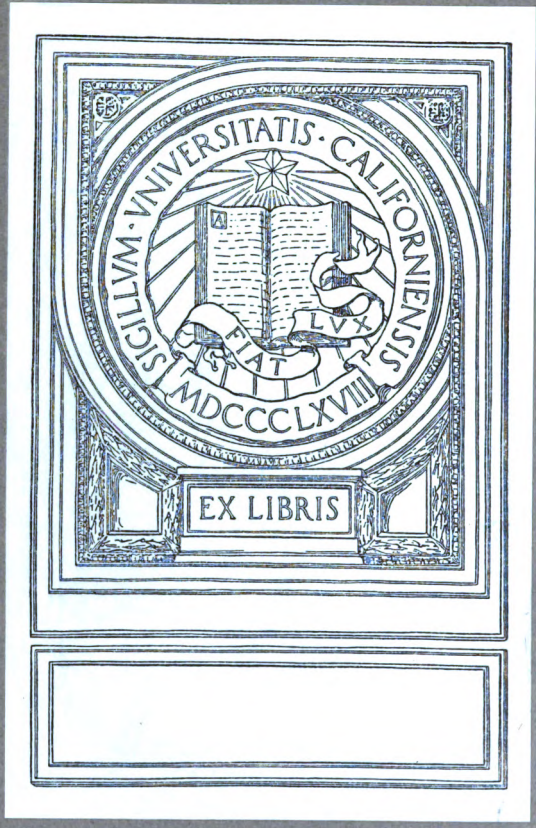
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com



Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

THE STRATEGY AND TACTICS OF AIR FIGHTING

BY

MAJOR OLIVER STEWART

M.C., A.F.C.

WITH INTRODUCTION BY

WING-COM. W. G. BARKER, V.C., D.S.O., M.C., A.D.C.

ROYAL CANADIAN AIR FORCE

WITH DIAGRAMS

LONGMANS, GREEN AND CO.

39 PATERNOSTER ROW, LONDON, E.C.4

NEW YORK, TORONTO

BOMBAY, CALCUTTA AND MADRAS

1925

Digitized by Google

UNIV. OF
CALIFORNIA

Made in Great Britain

Digitized by Google

CONTENTS

		PAGE
INTRODUCTION		1
PREFACE	SCOPE OF THE TREATISE. DESCRIPTIVE METHODS	3
CHAPTER		
I.	ATTACK STRATEGY: GROUND WORK	13
II.	,, ,, DISPOSITION OF PATROL	20
III.	,, ,, PRELIMINARY OBSERVATION	32
IV.	,, ,, CONCEALMENT	42
V.	,, ,, BALLOONS, AIRSHIPS, SCOUTS AND NIGHT-WORK	50
VI.	DEFENCE STRATEGY	56
VII.	ATTACK TACTICS: GENERAL	64
VIII.	,, ,, SINGLE-SEATER *v.* SINGLE-SEATER	77
IX.	,, ,, ONE SINGLE-SEATER *v.* FORMATION OF SINGLE-SEATERS	88
X.	,, ,, SINGLE-SEATER FORMATION *v.* SINGLE-SEATER FORMATION	95
XI.	,, ,, SINGLE-SEATER *v.* TWO-SEATER	103
XII.	,, ,, SINGLE-SEATER *v.* FORMATION OF TWO-SEATERS	118
XIII.	,, ,, LAYER FORMATIONS, AIRSHIPS AND CAPTIVE BALLOONS AND NIGHT-WORK	128
XIV.	DEFENCE TACTICS: SINGLE-SEATER *v.* SINGLE-SEATER OR SINGLE-SEATER FORMATION	135
XV.	,, ,, SINGLE-SEATER FORMATION *v.* SINGLE-SEATER FORMATION	145

C41535

Digitized by Google

CHAPTER		PAGE
XVI.	Defence Tactics One or More Multi-seaters *v.* Single-seater Formation -	152
XVII.	,, ,, Anti-aircraft Fire - - -	163
XVIII.	Aerial Gunnery - - - - - - - - -	168
XIX.	Flying Training and Moral - - - -	176
XX.	Conclusion - - - - - - - - - -	181
Appendix	- - - Air Fighting in the Future	189

Digitized by Google

UNIV. OF CALIFORNIA

INTRODUCTION

BY WING-COMMANDER W. G. BARKER V.C., D.S.O., M.C., A.D.C.
ROYAL CANADIAN AIR FORCE

THE clear way in which the practical aspect of air warfare has been presented by the author deserves a word of special commendation. Much light is thrown on fighting in the air and the various duties carried out by fighting pilots have been set forth in a manner readily understandable.

The development of air power has created many problems affecting Great Britain. The English people should know that in so far as war is concerned England is virtually no longer an island. Enemy bombers would be able to cross the Channel in a few moments without opposition, except from aircraft.

The Royal Navy and the Army would only be able to assist in the defence of this country against air attacks by supplying anti-aircraft gun-fire. But it should be realized that this method of defence has its limitations. Attacks delivered from low or high altitudes, or in weather conditions unfavourable for anti-aircraft guns, would easily penetrate such defence.

The only effective defence Great Britain can have is an Air Force of at least a one-power standard. It should be sufficiently strong not only to offer effective protection over Great Britain, but to carry the war into the enemy's country by attacking civilian and industrial centres.

Digitized by Google

I hope this book, in which Major Stewart makes clear the possibilities of air action, and describes the strategy and tactics employed, will bring home to the general public a sense of their responsibilities with regard to air preparedness and air defence.

W. G. BARKER
Wing Commander
Royal Canadian Air Force

Digitized by Google

PREFACE

SCOPE OF THE TREATISE AND DESCRIPTIVE METHODS EMPLOYED

As far as I can ascertain no book has yet been published which attempts to deal analytically and exhaustively with the strategy and tactics of air fighting. *Winged Warfare*, by Major W. A. Bishop, V.C.; *Five Years in the Royal Flying Corps*, by Captain McCudden, V.C.; *The Red Air Fighter*, by Baron Von Richthofen; and *Mes Combats*, by Capitaine René Fonck, do give a certain insight into air strategy and tactics, but their main purpose (which they admirably fulfil) is to provide an interesting story and not to present information for the reader. It would be a waste of time in such books to probe deeply the secrets of successful air fighting. Analysis of the new forms of tactics and strategy would be inappropriate when introduced in books such as these, moreover it is very doubtful if the supremely successful air fighters could give in detail the reasons for their manœuvres in battle. It is proverbial that the brilliant musician often makes a poor teacher. He can play, but he cannot analyse exactly how he plays; or, having made the analysis, he does not give a lucid exposition of it to his pupils. Besides there are many different opinions upon the details of air strategy and tactics, and the expert is apt to give undue prominence to his own views while neglecting the good points in the views of others.

I think that this is the first book in which an attempt has been made to sift the evidence of the more successful air fighters and to deduce from it definite strategical and tactical methods. Part II. R.A.F. Training Manual mentions a few of the more obvious tactical manœuvres but what information it gives is mostly vague and often inaccurate.

Digitized by Google

I have attempted to avoid as much as possible introducing personal opinions upon air fighting, and to present only a system based upon the work of the most successful fighters, such as Guynemer and McCudden. When I have noted individual peculiarities in one man's methods, I have mentioned them parenthetically; but generally the information from totally different sources fits together accurately and leaves no doubt in my mind that all successful air fighting is based upon the same principles.

Ground work is only mentioned when it has an intimate bearing upon air work such as in the decision as to the size and disposition of a formation of aircraft and the time the formation is sent out on patrol. Beyond this consideration of ground work, the book refers only to the period after the aeroplanes have left the aerodrome until they land again.

The treatise is limited to strategy and tactics in the air. It does not deal with bombing, reconnaissance, photography or naval and military co-operation, into all of which a "ground" element enters, but it does deal with the escorting of machines engaged on such work. A treatise on naval and military co-operation with the Air Force would require contributions from naval and military officers. Bombing, although its effective employment is dependent upon air fighting, is not strictly a phase of air fighting, but defence by aircraft against bombing is a phase of air fighting and has been examined at length.

A few remarks are required to vindicate my use of the words "strategy" and "tactics."

In air fighting, as it will become clear later, there are two distinct operations. There is the preliminary manœuvring before the opposing forces have joined issue and while they are, perhaps, only just visible to each other in the distance; and there is the manœuvring after the forces have joined issue by one launching an attack upon the other. These two operations are distinct from one another and, before fighting in the

Digitized by Google

air can be discussed analytically with any profit, it is necessary to draw the line separating them.

Etymologically the word strategy refers to the leading of an army, and the word tactics to the arranging of an army. I therefore apply the word strategy to that branch of air fighting which consists in the preliminary leading of a patrol of aeroplanes in such a manner as to allow the enemy to be engaged under the most favourable conditions; and I apply tactics to the manœuvring which takes place after the issue has been joined and the object of which is to arrange the machines in positions from which they possess a superiority of striking power or in which they are adequately defended. Strategy, in other words, guides the pilot's actions when he sees his opponent as a speck in the distance; tactics guides his actions when the machines are circling round each other or otherwise manœuvring close together.

Admittedly strategy has come to mean the wider (but not more intricate) geographical problems which precede the movements of fighting forces. In this sense there is a strategy of air fighting which is practised by high officers upon the ground. With that branch of air fighting I have nothing to do. As it has been mentioned the air strategy of which I shall speak is strategy *in* the air. In using the two words strategy and tactics as I have done I have not strained them out of their true meaning, indeed it seems that the words apply to the new kind of warfare with an exactness they were beginning to lose in the old. And if the two phases of war in the air: when the machines are far distant from one another and when they are close together, are not to be known as strategy and tactics, by what suitable terms are they to be known and differentiated?

And now as to certain expressions which I have permitted myself in describing aerial manœuvres and to which exception might be taken.

The vocabulary of the air is growing gradually and

Digitized by Google

many of the words which take root in the vocabularies of practising airmen eventually will pass into the language. Many of the hard-hitting words originated by seamen have helped to enrich our tongue, and so will many airmen's words. But there is a difference between the words which grow from the natural demand of the airman—whose general, apart from his technical, vocabulary is usually limited—and those words which are exploded into the world by official orders and proclamations and similar adventitious means.

The word "zoom" seems to me to be an unobjectionable word. Zooming means, according to the British Engineering Standards Association's Glossary of Aeronautical Terms, "Utilizing stored energy in the form of air speed in order to gain height by a steep climb." I have employed the word zoom where necessary.

The word "Scout," meaning a single-seater fighting aeroplane has been barred officially, and the words "single-seater fighter" have been substituted. This substitution by order is definitely bad. Admittedly "Scout," when applied to a machine whose sole business is fighting is inaccurate, but the word in its new application had grown naturally in the airmen's vocabulary and it is, in common with all words which grow naturally, strong and short. "Single-seater fighter" is too long and in practice it has been already clipped either to "single-seater" or to "fighter." "Single-seater" is still a mouthful and an evil tasting mouthful, too; on the other hand "fighter" is not sufficiently definite. There have been and still are two-seater fighters and, in the future, there may be three, four, five or more-seater fighters. The natural growth "scout" should have been cherished.

Instead of being cherished it has been rooted up with all the pomp and circumstance of the powers (whoever they may be) who concern themselves with air nomenclature. But "single-seater fighter" has consolidated its position, so I say farewell to

Digitized by Google

" scout," an old friend, and throughout this book I employ the expression single-seater fighter, or single-seater, or sometimes fighter when referring to this type.

I have thought no excuse or explanation necessary for the use of the expressions: " enemy " aeroplanes, territory, etc., " friendly " aeroplanes, etc., and the " lines." The free employment of these terms permits explanations to be given more clearly and much more shortly than would otherwise be possible. I have used the expression " Immelman turn," meaning a cross between a loop and a 360° turn. The name was originated because the turn was popularly supposed to have been invented as a tactical manœuvre by Immelman, the fighting pilot.

I must now deal with one objection that might be raised against the methods I have employed in my descriptions. I have invariably assumed a " line " between enemy and friendly territory, and it might be argued that, for this reason, my strategy and tactics are inapplicable to mobile warfare. Now as far as the airman is concerned there must always be friendly and enemy territory; there must be places where he can land his machine in security and where repairs and refuelling can be carried out without great danger of attack from ground forces or from sea forces. Aeroplanes could not operate unless there is some area which may definitely be described as " friendly " and some area which may definitely be described as " hostile." If these hostile and friendly areas be admitted to exist, an area which, to employ the familiar expression, may be called the " lines " must also exist.

Moreover, it is the opinion of many able writers upon modern warfare (Pierrefeu among them) that the day of the mobile battle is over, and that, in all future wars of any magnitude, there will be, soon after the first shock of battle, a fixed line, upon either side of which infantry will be entrenched in exactly the same

Digitized by Google

way as during the last war. It is likely that future wars will be either repetitions or extensions of the last war, and it is extremely unlikely that any return to Napoleonic conditions will occur. Systems of warfare do not develop backwards and double upon their own tracks, any more than systems of commerce.

A preliminary skirmishing, it is generally conceded, might precede the stable and entrenched condition; but, during that preliminary skirmishing, airmen will fight in the same way as they do when the stable condition is reached except that they must regard a wide strip of ground as the "lines" instead of a narrow one.

Aerial warfare, it must strongly be insisted, is a new warfare which has no connection with land or sea warfare. Whether an air fight takes place over the sea or if it takes place over the land, the fight will be conducted upon identically the same lines. And although its immediate results are only destruction, the air war will precede and be the indispensable accompaniment of all other aerial work. Until the air war has been fought or is being fought, no reconnaissance, bombing, photographic or artillery observation machines will be able to do their work. Air war is now the essential preliminary to all other war. But without a clear comprehension of the principles of strategy and tactics in the air, no air force could hope to gain an ascendancy over an enemy unless it possessed an overwhelming superiority in both the quality and the quantity of its material. On the other hand, if the fighting men in an air force were outnumbered as two to one by their opponents, possessed machines of equal excellence with those of their opponents and yet alone understood the exact principles of strategy and tactics in the air, the contestants would be about equally matched. But it is scarcely necessary further to stress the importance of strategy and tactics, which is the brain work, for, in every kind of fighting, from boxing to billiards, the value of such work is appreciated.

Digitized by Google

Analytical examination of the strategy and tactics of air fighting enables one to seize upon and to state methods for bringing down enemy machines without the loss of friendly machines. Scientific aerial warfare is a very different thing from pure recklessness. Recklessness has nothing whatever to do with making a skilled air fighter. Reckless pilots are the easiest prey to the calculating fighter who watches his chance; and it must be made clear that the efficient air fighter must not only bring down enemy machines but he must not himself be brought down. This sounds an obvious thesis; but during the war, the only war to which we may look for knowledge upon the subject, there were many pilots whose strategic and tactical knowledge could be summed up by the single word "attack." Most of these pilots were, in the natural course of things, shot down at once by the enemy. Some lived long enough to perform one heroic act; to dazzle the enemy by one incredible flash of bravery, but always the end came soon.

The courage of recklessness cannot be denied, but the reckless pilot is of little use to his country when compared with the scientific fighter. And the scientific fighter also needs courage if he is to be successful, for on occasions the best laid plans go wrong, and then it is only dash and the will to win that can be of assistance. In fact when the scientific fighter is cornered he often shows as violent a determination as the reckless fighter.

The historic fight in which the German airman, Voss, was killed may be mentioned. Voss fought against six of our machines until he was shot down. And I remember seeing one of our own airmen, who was noted for his carefulness, fight with incredible ferocity when he was cornered by four enemy machines. He continued to fight after his machine had caught fire. Captain Ball, V.C., is often quoted as an example of the reckless pilot who is successful. But Ball worked on a system which, in his day, was far more elaborate than that used by any other airman; and,

Digitized by Google

though he certainly took great risks he always had a definite line of action mapped out in his mind.

In dealing with the various phases of scientific air fighting the point of view of the pilot of a single machine or of the patrol leader is given unless otherwise stated. Usually the patrol leader's actions are in themselves sufficient explanation of an aerial engagement; for the other pilot's actions follow inevitably the patrol leader's actions in the manner shown in a subsequent chapter. However, when doubt might arise full explanations have been given.

The first part of the book is devoted to strategy and the second part to tactics, and in both strategy and tactics offence is dealt with before defence. This arrangement seems clearest, and that is the only reason it has been adopted.

It is remarkable that many professional flying men, both in and out of the service, are ignorant of the existence of strategy and tactics in the air. And, apart from a few spasmodic attempts, none has so far seen fit to enlighten them. This is partly because, during the last few years, war subjects have been avoided rigorously in conversation and in writings as a natural result of the urgent desire to forget about the war. But the lessons of the war should not be forgotten; and above all the unique and enormously valuable lesson provided by the first and only aerial war of any magnitude must not be forgotten.

France and Britain possessed air fighters who amassed a great amount of important information about air warfare. There is no reason why our fighters should have to start discovering this information all over again if another war is forced upon us.

But besides being valuable as a lesson, the methods of successful air fighters are in themselves of absorbing and romantic interest to all who have flown and to all who take an interest in air matters. The very intricacy of the subject where it would seem, upon superficial examination to be most clear, coupled with its

Digitized by Google

novelty, gives it a strong individual attraction. The novelty of the subject has, however, made the compilation of this book, which can be formed upon no ready-made model, a matter of some difficulty.

If I have achieved my purpose, this treatise should take to pieces and thoroughly examine every part of the complicated mechanism of war in the air. It should examine them not in the light of the last war but in the light of the fundamental facts which were then established. For since there has been only one war in the air, all knowledge of air fighting must be deduced from and referred to that war.

It is for this very reason that I have been cautious in accepting any of the strategical and tactical theories advanced recently in the Royal Air Force. While recognizing the great value of advancing such theories, since any discussion of the subject assists in obtaining a clearer view of it, I do not feel that they should be admitted among the proven practices of the great air fighters without some proof of their efficacy.

And since the war it has not been possible to obtain a vestige of such proof, because no manœuvres ever have been carried out which approach to within measurable distance of imitating the conditions of actual warfare. The mock combats which are fought between R.A.F. pilots and between formations provide useful training; but they conjure up an imaginative picture of an air warfare which possesses no resemblance to the reality. No form of realistic air manœuvres has been originated in which these theories could have a fair test. However, where the theories own intrinsic interest I mention them, with a view to stimulating thought, but not with a view to advocating their employment on active service except experimentally.

Throughout the treatise I speak primarily of the single-seater as the fighting aeroplane because, all over the world, the single-seater has been adopted for that purpose. In this country it is likely to remain the fighting aeroplane for some time, and when speaking

Digitized by Google

at Cambridge on 29th April, 1925, Sir Hugh Trenchard, Chief of the Air Staff, said that the air force for the defence of these islands is partly composed of fighting squadrons "which are at present single-seaters *and will probably remain so.*"

It will be many years before the single-seater is superseded as the fighting aeroplane, if it is ever superseded. And even if it is the principles of air strategy and tactics will remain the same.

The eight line drawings illustrating various points to which I have drawn attention in the text were made by Mr. Leonard Bridgeman. The sketch for the dust cover was made from a photograph kindly supplied by the *Daily Mirror*.

Digitized by Google

CHAPTER I

ATTACK STRATEGY

GROUND WORK

"THIS branch of work alone, just studying the habits, work and psychology of the enemy aeroplane crews, constitutes a complete education of great interest." That is what McCudden said; and, although he may not have known it, he was describing his own strategic education.

For the "habits, work and psychology" of enemy aeroplane crews are the kernel of strategic knowledge, to reach which deceptive appearances must be broken down by a long process of intelligent observation. The habits of enemy airmen can be closely studied only from the air; but officers of the higher command who do not fly should take pains to become as thoroughly acquainted with them as is possible at second hand.

Ground strategy as well as air strategy is based upon a knowledge of the enemy's habits, and a wing commander cannot effectively arrange the patrols which are to be carried out by his wing, unless he appreciates fully the strategic principles of air fighting.

The size and disposition of a patrol can be decided only by one who understands what kind of enemy the patrol will be required to meet.

The strategic development which led up to the first air battles in which very large numbers of machines were engaged, emphasizes the importance of the higher command possessing an exact understanding of strategy in the air. (This strategic development led

Digitized by Google

to much controversy which need not be entered into here.)

This is what happened. A patrol was sent out at a certain hour, say nine o'clock, every morning, to photograph a certain area of enemy country. The patrol consisted of six machines. The enemy, after three or four days, noted the regularity with which this patrol put in its appearance at the same time and over the same ground. So an enemy patrol of six machines was awaiting our patrol on the fifth day. A fight ensued. On the sixth day out photographic patrol of six machines was escorted by three single-seater fighters. Another fight ensued with the enemy machines which had been ready waiting. On the seventh day there were twelve enemy machines waiting; but our patrol had also been increased to twelve machines. On the eighth day our twelve machines encountered something between twenty and thirty enemy aeroplanes. On the ninth day our entire wing went out together in three great layers. Two layers of single-seater fighters high up; and, low down, the six photographic machines.

Losses on both sides had been fairly even, but, in the first great evenly matched battle, it was judged that the enemy had suffered a shade more severely than ourselves.

This example shows how strategic ground work may influence the course of events in the air. The battles that followed upon the happenings described, with gigantic formations engaged on both sides, were the direct and natural result of sending over a patrol at the same time and over the same ground every day. When an attack is foreseen defence measures are strengthened, consequently offence measures must be strengthened as well.

From examination of this example an idea may be gained of how the decision as to the size of the patrol, its disposition, and the time at which it is sent out may be made.

Digitized by Google

First take the size of the patrol. The decision as to the size of the patrol is obviously influenced by the known enemy air activity over the ground which is to be patrolled; but it is also influenced by our own former air action. Thus, if a photographic patrol is to be sent out at 9 a.m.; and if no friendly patrol has been flying over the area to be photographed at 9 a.m. on previous days, it would be strategically correct to send only one, two or three machines over at a great height and unescorted, or alternatively, to send six machines flying low.

But if a friendly patrol had been flying over that same ground at 9 a.m. on two previous days a strong escort of fighters would be necessary regardless of whether the photographic machines were flying high or low to ensure that the work of the photographic machines should not seriously be interrupted. This is an obvious precaution, which may be the reason it was so often overlooked in the war.

It has been said that, given favourable conditions, one, two or three machines may be sent over very high. But it must be added that one is better than two or three, because the object of this particular strategic method is to give freedom of action and the full chance of concealment. Often a single machine flying very high can cross the lines and start its work before it is observed from the ground. And machines after taking off from the ground require a known time to climb to the attack. The single high photographic machine was much used by the Germans but not by ourselves during the war.

If a patrol is expected to meet opposition, and if the main object of the patrol (photography, bombing or reconnaissance) demands that it shall pass over certain ground, then an escort of single-seater fighters (or two-seater fighters) is necessary. Thus six photographic machines may be sent over the lines escorted by six fighters flying anything from 1,000 to 4,000 feet above the photographic machines.

Digitized by Google

To be successful, the patrol which must (owing to the nature of its mission) follow a certain definite route, must always be stronger, under given conditions of hostile activity, than the patrol which is free. A photographic patrol might require an escort of 12 single-seater fighters in order to proceed over ground which could be flown over safely by a patrol of three fighters on free offensive work.

When large numbers of machines are sent out together the layer formation is the best disposition for them. This is because it is a principle of air strategy that height is an advantage. The reason for this will be shown later, but here it may be said that layer formations are generally better than very large mass formations.

And now how may the higher command so arrange the purely fighting patrols so that our machines are given the best chance of doing their work well? The answer is that the higher command should allow the maximum amount of freedom possible for the patrols. That is of the first importance. Of the second importance is the spreading of a network of patrols, as it were, between enemy territory and our own territory. This network should prevent enemy machines from crossing our lines and should ensure that a large percentage of enemy machines are attended to by fighting patrols and prevented from molesting artillery observation, bombing, reconnaissance, photographic machines and machines engaged in low-flying attacks upon ground troops.

Of course no network could be spread so effectively as to catch all enemy machines even on a small front; but that is the objective which should be aimed at in the ground work. Patrols should be given instructions to watch the sky over the line between x and y between the heights of a and b. The pilots should not be told to *patrol* that area but to *watch* it. For the difference between patrolling in a certain area and watching that area is, as it will be seen later, very great, and

Digitized by Google

whereas one order would restrict the movements of the pilots and impair their fighting power, the other would allow them full scope to engage the enemy to the best advantage.

But, above all, the higher command in issuing their orders should keep in mind the value of the small patrol: three machines or even a single machine can do tremendous execution if allowed absolute freedom. The very small roving formation can do its execution without itself running extreme risks. Especially valuable is the small patrol for defensive purposes against machines attempting to cross the lines for photographic or reconnaissance work.

A few words must be added about night attack. With the recent improvements in the French method of picking up hostile machines at night and advertising their presence to defending aeroplanes, night fighting will be more extensive and more frequent in any future war than it was in the last one.

The French method of detection at night is briefly as follows: Many special lamps which throw very wide beams (not searchlights) are directed upwards from the ground. A friendly machine flies high over the lamps and, when the enemy machine passes between the friendly machine and the lamps, the enemy machine shows as a shadow crossing a lake of light.

Another recently introduced system of detection is operated by means of wireless. These improvements make a definite statement necessary as to the orders that ground staffs should issue to defending single-seater patrols for night fighting. Again freedom is the first consideration and strategically the best policy would be to order defending patrols to remain in the air for a certain time and also to inform them exactly where the ground aeroplane-locating stations are situated. Beyond giving the patrols freedom and information, the higher command could, at first, do little to assist night fighting machines in another war.

Digitized by Google

Methods of detecting and indicating hostile machines, until lately, have been so imperfect that the strategy and tactics of night fighting in the air are as yet uncertain and nebulous.

The duties of the higher command in issuing their orders for air patrol work may be summed up as follows: The size of the patrol must depend on the known strength of the enemy and on our own previous actions; the disposition of the large patrol should, where possible, be in layer formation; the area to be watched should be clearly indicated; escort patrols should always be stronger relative to offensive patrols; the pilots should be given the maximum possible amount of freedom; the effect of the times at which patrols are sent out should be borne in mind.

Wireless and the use of "bait" require a short note. The higher command could use wireless to inform pilots where hostile machines have been seen and for the purpose of massing patrols where the strength of the enemy attack demands such a course. Whether the additional weight and the extra distraction of yet one more instrument for the pilot of a high performance fighter to attend to is subversive and to be avoided, or if the advantages accompanying the use of wireless outweigh its disadvantages, are questions to which time alone will provide an answer. It is certain, however, that wireless will be used at first by all machines if another war breaks out, and so the higher command should be prepared for the additional responsibility entailed by having control of the machines while they are in the air.

The use of "bait" is the only other consideration which must be taken into account when discussing the strategic ground work of the higher command. Two or more machines (usually large machines) are ordered to fly low while a patrol of fighters flies as far above them as possible without losing sight of them. Enemy machines are attracted by the apparent helplessness of the two low machines, and immediately launch an

Digitized by Google

attack. Down come the fighters from their position of strategic superiority.

This trick was used successfully by both sides in the war. The trick is of great value when the enemy is in the habit of attempting to avoid engagements; it sometimes will draw a timid opponent.

Digitized by Google

CHAPTER II

Attack Strategy

DISPOSITION OF THE PATROL

In the last chapter the strategical problems which confront the higher command in issuing orders for air work and which bear immediately on air fighting were examined. In this chapter the more complicated problems which confront the patrol leader will be introduced, and the final instructions which he must issue to his patrol will be outlined. Then it will be possible to examine the actual air work, for, from the moment the wheels of the aeroplanes leave the ground, the patrol should act upon a definite strategical system.

Although wireless may do away with the necessity for other forms of communication between machines in the air, it is advisable to mention the two simple, clearly-defined signals which were used extensively during the war and which are made with the aeroplanes themselves. Anyhow these two signals form a valuable and essential adjunct to wireless communication, and the patrol leader should ascertain that all his pilots understand them.

One signal, which indicates that enemy machines have been observed or are actually attacking, is made by rolling the machine alternately from one bank to another. The other signal, which indicates that the aeroplane making it is suffering from engine trouble, or that the pilot is wounded, is made by a fore and aft movement—like switchbacking. The two signals can give to the patrol leader nearly all the information he wants from his pilots while he is directing operations.

Digitized by Google

The ground work of the leader consists in passing on to every man in his patrol the orders of the higher command as to the area to be patrolled and the length of time for the patrol. In the air it is a mistake to lead men into battle without their knowing as much as possible of the nature of the work they are about to perform and the strategy and tactics that will be adopted during the fight. Although there must always be unquestioning obedience to the leader, the air demands even more individualism from those who fly than the sea demands from those who sail. There are so many occasions when the pilot must think for himself that any attempt for a patrol leader to adopt an aloof secretive attitude about his plans or to imagine that all the responsibility can rest upon his shoulders alone would be fatal to fighting efficiency. All members of the patrol must possess a clear and complete understanding of the work to be performed.

Thus the leader might say that he is going to watch for hostile machines crossing the lines and flying over friendly country. Or he might say that he intends to engage enemy artillery observation machines. And if he has any broad scheme in his mind in addition to his instructions from superior officers and apart from purely strategical and tactical considerations, he certainly should divulge it to all his subordinates.

Besides these outlines of the nature of the work in hand, the patrol leader must give detail instructions as to the disposition of the machines forming the patrol.

Although the questions as to whether the patrol shall be in layer formation or mass formation and as to the size of the patrol, may be decided by a ground officer, the *shape* of the formation and the approximate distances between machines will be decided by the patrol leader.

The details of disposition were settled empirically in the war, and from that settlement there is no reason to suppose that any future war would cause a departure.

Digitized by Google

In fact the disposition of the machines in a patrol is based upon the principles of aerial warfare, and is therefore not a matter which is subject to alteration as changes in material occur.

Consider a patrol of six machines (this being a convenient number for purposes of illustration). Broadly it may be said that the formation flying practised in peace time by R.A.F. squadrons and demonstrated on occasions like aerial displays, provides an example of how not to fly in formation in war time.

Three needs govern the disposition for active service. One need is to present a difficult target for anti-aircraft fire, another is so to dispose the machines that they may quickly come to each other's rescue in a fight, and the third is for the pilots to possess a certain latitude for individual, as apart from mass, manœuvring. This individual manœuvring is necessary, amongst other things, in order that the pilots may command the maximum possible fields of view.

The first need, the presentation of a difficult target or an indefinite point of aim, for anti-aircraft fire, is fulfilled by scattering the formation. A closely packed formation is clearly a better defined target than a scattered one. But besides this a good deal of alteration of course and height is necessary if hostile anti-aircraft fire is to be given as difficult a task as possible.

Now a close formation is restricted in its powers of manœuvre both as a formation and as individual machines. The leader of a closely packed formation cannot make a very sudden turn to right or left or a very sudden change of height, without risking a collision; or at least causing a certain amount of confusion in the formation. A closely packed formation is less mobile and presents an easier target for A.A. fire.

In order to present a difficult target for A.A. fire a scattered formation is therefore necessary. The second need, which is to dispose the machines so that,

Digitized by Google

in battle, they may quickly aid each other, also requires a definite disposition.

In a patrol the leader leads the attack; and, when he engages an enemy machine another enemy machine will immediately attempt to launch a counter-attack against him. If he is to be allowed to concentrate on bringing down the machine he has first attacked, he must be sure that no other machine will be permitted to attack him effectively from the rear or from the

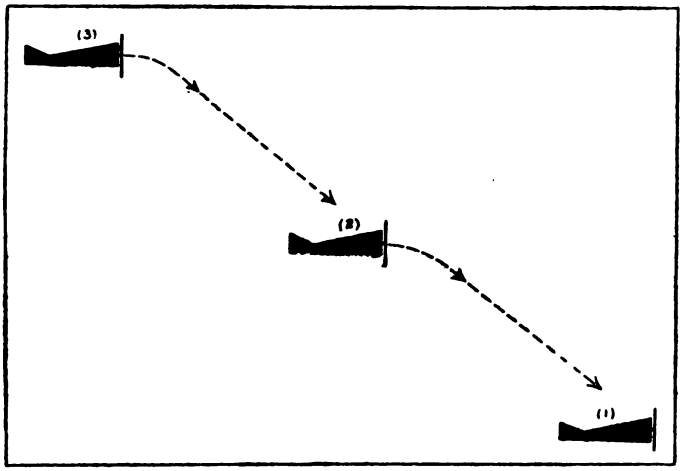


FIG. 1. Step Formation. Side Elevation. Machines 2 and 3 can catch the leader, 1, by diving.

flanks. The rest of the patrol must be ready to guard their leader. If the formation is to be a scattered one, how can this be done? Simply by having the machines in steps going upwards from the leader to the last machine (Fig. 1). This gives every machine an extra store of speed, as it were, for, if the last machine wishes to reach the leader, it can always add the speed gained by diving to the speed gained by its engine.

There is another reason for the step formation. If the last machine is attacked by enemy machines, its

Digitized by Google

pilot must immediately apprise the leader of his plight, or he will risk being cut off from the patrol. He can do this by diving forward past the leader, and he can only dive forward past the leader without dropping below the patrol if he originally possesses extra height.

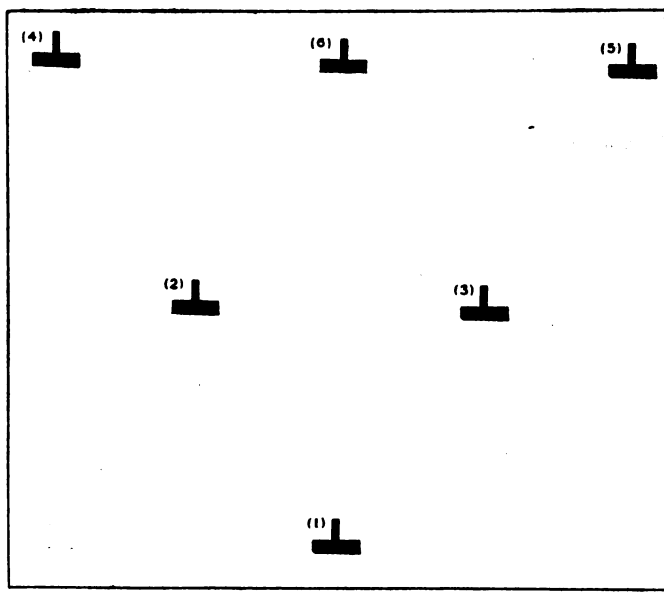


FIG. 2A. Disposition of patrol of six single-seaters. Plan view. (1) Leader. (6) Sub-leader.

A scattered disposition is needed in order to allow each pilot to use his eyes to the fullest possible extent. Naturally more attention to flying is required by, and less individual power of manœuvre is permitted to, pilots flying in very close formation than in scattered formation. As the look-out kept by the patrol is of vital importance to its safety and striking power, the need for allowing pilots to fly under the easiest possible conditions is clear.

Digitized by Google

We find, therefore, that the patrol must be scattered and arrayed in steps with the rearmost machines highest. The next consideration is the placing of the individual pilots. Who should be the last man, who on the right, who on the left and so on.

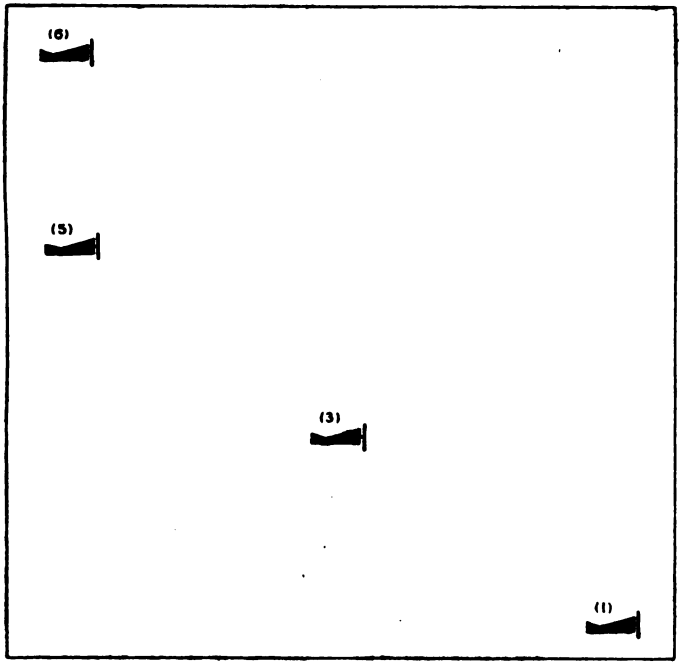


FIG. 2B. Disposition of patrol of six single-seaters. Side elevation.

The patrol leader must be acquainted intimately with his pilots. He must know their personal qualities and he must know the extent of their experience. This is a part of the patrol leader's work. Knowing these things he must place his men (considering a patrol of six) as follows: Novices, or the least expert fighters, should fly on the leader's right and left, because those are the safest positions. The novices,

Digitized by Google

in accordance with the "step" plan already outlined, will fly higher than the leader and well away from him. The next pair, who will be experienced men, will fly above and on the right and left of the two novices so that a wedge shape is formed. The sixth man, who is the sub-leader and who should be the man whom

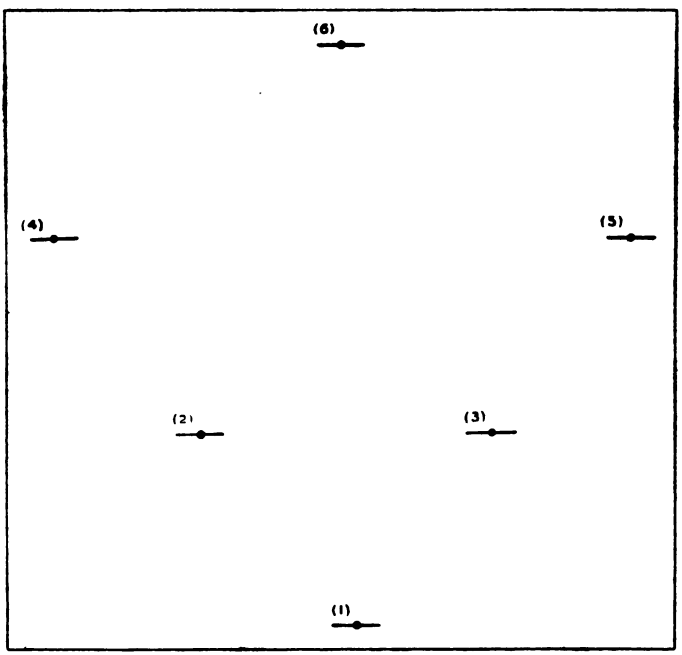


FIG. 2c. Disposition of patrol of six single-seaters. Front elevation.

the patrol leader considers to be the most highly skilled of all, must fly above and between the two last machines (Fig. 2. A, B and C).

That is the disposition for a patrol of six, and a brief examination of the broad reasons for that disposition will show the connection between it and the principles of air tactics; a connection which will be

Digitized by Google

clearer when later on the tactical questions themselves have been examined.

The leader is the striker. He leads the attack and therefore he must be protected from the rear. The novices come next because in that position they have

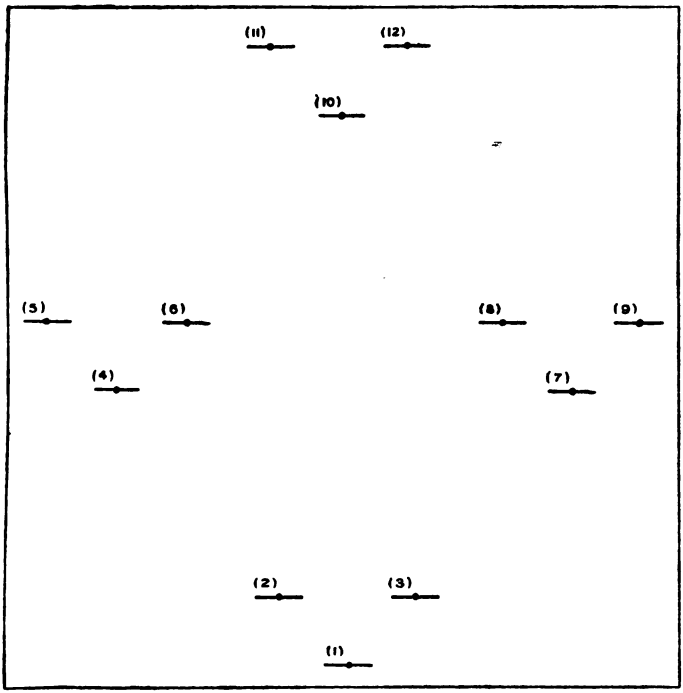


FIG. 3. Disposition of patrol of 12 single-seaters grouped in threes. Front elevation. (1) Leader. (10) Sub-leader.

protection both fore and aft. The tail part of the patrol, formed by three machines, the sub-leader being highest, is the vulnerable spot and requires the best men.

Formations of three consist in the leader and two machines above him and to his right and left. Formations of nine may be considered as three groups of three

Digitized by Google

A formation of twelve may be in two sixes or in four threes. Four threes is usually better. The four sets of machines take up positions according to the principles enunciated for the patrol of six. Thus the leader of the 12 machines will be in front with two

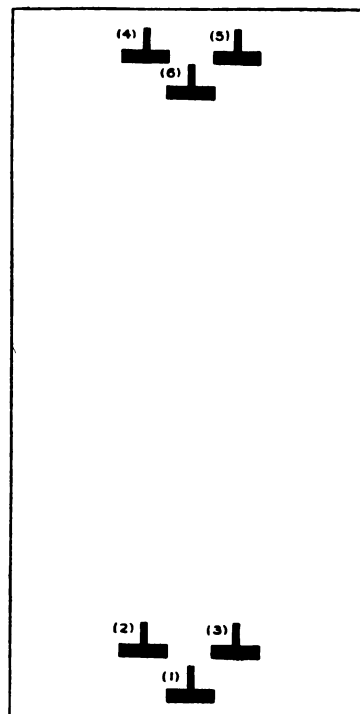


FIG. 4A. Disposition of patrol of six single-seaters in two layers. Plan view. (1) Leader. (6) Sub-leader.

men on his right and left and above him. Two groups of three will fly above and on either side of the leading group and a group of three (containing the best men in the patrol) will fly centrally and highest of all (Fig. 3).

Any mass formation, no matter how large, can be

Digitized by Google

organized if it be remembered that *the point is the striking part and the tail the most vulnerable part in any and every formation.*

Layer patrols virtually consist in a number of correctly disposed patrols, each complete in itself,

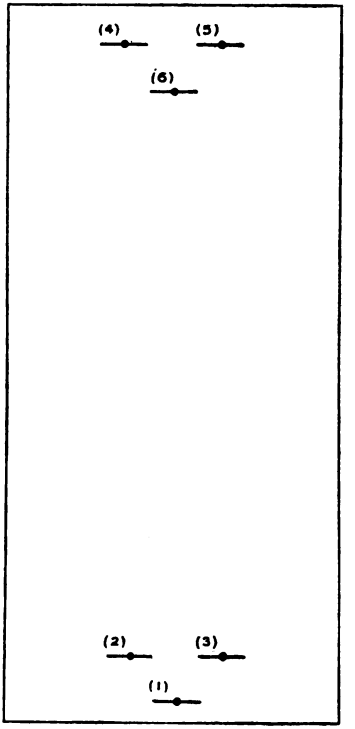


FIG. 4B. Disposition of patrol of six single-seaters in two layers. Front elevation. (1) Leader. (6) Sub-leader.

flying above each other with as great a distance between each patrol as is compatible with a good view being kept from the top one on to the next lower one and from the next lower one downwards according to how many layers are being used (Fig. 4, A and B).

Digitized by Google

All these details of formation disposition of course must be stated to the pilots before the machines leave the ground. To complete this outline of ground instructions mention must be made of escort work.

In escort work the higher command should fix a *rendezvous* and they should also fix appropriate heights for the various parts of the patrol. Thus an order might appear: "Rendez-vous over Blank wood at 11.00 hours. 3 Photographic machines from *x* squadron at 10,000 ft. Escort of 6 fighters from *y* squadron at 15,000 ft. and escort of 6 fighters from *z* squadron at 20,000 ft." The patrol leaders would then allow sufficient time for their patrols to climb to the necessary heights by 11 o'clock.

And now all the details of ground work which bear immediately upon the strategy and tactics of the air have been dealt with, and we may imagine that the engines of the patrol are started.

Three minutes before the patrol is due to leave the ground the patrol leader will taxi out on to the aerodrome and take-off. There is no need to take-off in formation although to do so saves time in the air. On active service, patrols usually took-off in formation. The matter is not of great importance, but if the patrol does not take-off in formation the leader must throttle down and wait until all his machines have reached their allotted positions before starting to climb rapidly.

As it has been pointed out, immediately the patrol has left the ground the leader must act strategically. The same need of immediate thought for coming events applies whether the patrol consists of a single machine or if of 50 machines.

Having collected his machines round him the patrol leader must take steps if possible to ascertain what enemy activity is in progress over or near the lines. He can gain this information while he is climbing.

Immediately after leaving the ground the leader of an offensive patrol will fly (climbing all the time) towards the lines. He will not approach very close

Digitized by Google

to the lines and will avoid coming under enemy anti-aircraft fire. While near the lines, the leader will watch for distant bursts of anti-aircraft fire and attempt to note if any enemy aircraft have crossed the lines at a height. He will also note the positions of hostile balloons and of hostile artillery observation machines.

Artillery observation machines are, for reasons which will appear later, difficult to spot from a great height and, if he intends to attack them later, it is advisable for the patrol leader to note exactly where they are operating before climbing. By the time these things have been noted the patrol (climbing slowly as must all patrols) may be at 10,000 ft. or more, and it will then be necessary to leave the vicinity of the lines and to go far away from enemy territory. If any enemy aeroplanes have been noted high up, or if artillery machines evidently observing a "shoot" have been seen, a definite plan of attack may already have formed in the leader's mind.

This plan of attack will influence the direction in which he climbs with his patrol in a manner that will become apparent later. Here it must suffice to say that the patrol leader will climb slowly in order to allow the slowest machine of his patrol to keep its position, in a direction that will take him far from any kind of enemy observation.

Digitized by Google

CHAPTER III

Attack Strategy

PRELIMINARY OBSERVATION

Before physical battle there must always be mental battle. The opponent must be watched and information of his movements must be obtained and considered in order to decide how best to attack him. As far as possible every stroke which the opponent may make must be thought of, and a counter stroke prepared; and conversely every attempt must be made to devise some stroke no thought of which has occurred to the enemy. In other words both sides will strive to surprise the other and to avoid themselves being surprised.

Surprise is more powerful than guns because it causes mental confusion, anyone who is surprised will lose his head. There are no men living who have the power to remain calm and clear-headed if they really are taken by surprise.

Presence of mind is simply the application of stored up knowledge; it is not some inborn faculty. Of course some people are liable to a greater state of confusion when they are surprised than others; but all, to a more or less extent, can be momentarily confused. Spring out from behind the doorway upon the man with nerves of steel and, unless he is prepared or unless he has been subjected to a similar experience on several former occasions, he will jump. Only if he has been expecting someone to spring out will he be able to remain calm and collected.

The pilot of an aeroplane has continually in his mind

Digitized by Google

the possibility of engine failure. Some pilots even when travelling by train, look for suitable landing grounds, so ingrained does the expectation of a forced landing become. It is therefore impossible for an engine failure to surprise those pilots because they are always ready for it. Car drivers, to take another example, usually remember their first serious skid. The car does things without the driver possessing the remotest idea of what it is doing. Afterwards, when he has thoroughly impressed upon his memory the probable behaviour of a car when skidding, he controls the car, as it is said, with perfect presence of mind. In air fighting, however, the methods of attack are so various that it is impossible for a man to train himself to expect them with sufficient exactness to ensure that his calmness will never be disturbed.

Surprise confuses the enemy and gives an overwhelming initial advantage to the side which effects it. From time immemorial the value of surprise has been understood; but air fighting is regarded in so curious a light—even by some flying men—that it is necessary to emphasize the importance of surprise strategy and to point out the curious fact that, in the air, surprise is as readily effected as it is upon the ground.

Therefore the first objective that the patrol leader must have in mind when he has led his patrol into the air will be to see if he can so place it as to effect a surprise attack upon some enemy formation. In other words the patrol leader must take, as the guiding principle of his strategic moves, to see without being seen.

In order to effect a surprise attack two preliminaries are essential. The enemy's movements, position, strength and nature must be known to the attackers; whereas the attackers' movements, position, strength and nature must be concealed. First the process of discovering full information about the enemy will be described, and in the next chapter the concealment of the attackers will be examined.

Digitized by Google

In order to launch a successful air attack the attacker should know:

1. The number of machines he is attacking.
2. The type of machine he is attacking.
3. The work upon which the machines he is attacking are engaged.
4. The nature of the formation of the machines he is attacking.

The importance of 1, the number of enemy machines, is obvious. The question of how far it is advisable to engage with a numerically superior opponent and the bearing that strategic position has upon such an engagement will be mentioned later; but now it need only be said that the approximate number of the enemy machines must be known.

2, the type of machine being attacked must be known, because this knowledge tells the attackers the speed, climb, manœuvrability, field of view, and gun positions of the machines.

3, the work upon which the machines are engaged must be known because this knowledge indicates the course which the machines will follow.

4, the nature of the formation must be known in order to estimate the balance of strategic disposition between enemy and friendly machines or, in other words, to estimate which formation possesses strategic superiority.

In order to fulfil requirements of concealment it is usually necessary for the preliminary observations to be made from a great distance; and, before proceeding to examine the methods by which the patrol leader will furnish himself with full information upon the four points enumerated above, a few words must be interpolated upon the actual observing.

Field glasses are not only useless for making observations of hostile machines in the air, they are a source of danger. Things move much too quickly in air warfare to allow the pilot to shut out so great a part of his field of vision for even a few seconds, with any

Digitized by Google

safety. Besides, when flying in formation, the glasses can be levelled only for very short periods and the eyes do not get accustomed to the medium in time to see better, or indeed as well as, with the naked eye.

Good goggles, on the other hand, are essential to the fighting pilot. Some successful pilots discarded the wind screens on their aeroplanes and used only their goggles as a protection against the air blast, and the method was a commendable one. A wind-screen is apt to encourage the inexperienced pilot to keep behind it, and there is nothing more dangerous, as will be seen when defence strategy is considered. Besides, a wind-screen blocks out some valuable view. Good goggles, arranged so that they do not fog up and in combination with a face mask to prevent frost-bite at high altitudes are desirable for the fighting pilot until such time as the experiments which are now being conducted, both in England and France, make available an absolutely reliable protective suit for airmen.

Captain Ball flew without face mask or goggles or even flying helmet on occasions; but, working at the very high altitudes attained by modern machines, this complete absence of protective coverings for the face would be impractical.

Assume that the pilot is well equipped, and understands that his two eyes unaided must do a great deal of hard, quick work while he is in the air, and we may come straight to the first fact of the four enumerated which the patrol leader must obtain before proceeding to decide on his mode of attack. The first fact is the number of enemy machines about to be attacked.

The sequence of observations probably will be as follows:

The patrol leader will search likely "layers" of air, beginning by examining as much of the hemisphere above him as possible and continuing his examination until he reaches directly underneath his machine.

Digitized by Google

He will then notice a single tiny dot in the extreme distance. It may be seen, according to the relative heights of the machines, against a background of fields or houses or sea or sky.

Having noticed this tiny dot the question of whether the machine is hostile or friendly must first be answered. This can be done sometimes by observing whether or not the machine draws anti-aircraft fire. The presence or absence of A.A. shell-bursts near the machine in conjunction with its position (over friendly or hostile territory) will often indicate whether the machine is friendly or hostile.

But a much more certain method of making the distinction between friend and foe is by observing the movements of the machine. The movements of enemy aircraft will be described however in considering their type and work, and therefore no more need be said here about this matter.

Having picked up a single enemy machine it is best to keep it in sight for several seconds before making observations in any other direction or it may be completely lost to view again. Then, having memorized its position by means of cloud shapes if possible or (if the machine is below) by means of landmarks, a thorough search must be made for other machines close to it.

Having found out whether there are other enemy machines near it, and having made a rough judgment of their number, the patrol leader has obtained his first fact and he turns to the second matter upon which he desires information—what type of machine is it?

When once the patrol leader has determined the number of the machines and their approximate position in the air, he can deduce their probable type. And this is how he does it.

Assume that our single-seater fighter patrol is flying near its ceiling and let all heights be described relative to the height of our patrol as high, medium and low. Development in machine performance is so rapid that

Digitized by Google

a more exact method of describing characteristic heights of machines is not available.

If six enemy machines are flying in formation high, it is probable that they are single-seater machines with guns firing only forward in the line of flight.

If the enemy is a single machine low down, it may either be an artillery observation machine or a machine engaged upon low-flying attacks upon ground troops, and our patrol leader, until he has made further observations, will be uncertain whether it is a single-seater or a two-seater.

If the enemy is a single machine flying very high, perhaps above our patrol, it will be a long-reconnaissance machine and probably a two-seater.

If the enemy is composed of a formation of six or twelve machines at medium height and two or three other machines below them, the higher machines are probably single-seater and the low ones photographic reconnaissance two-seater machines. (This deduction, as the others, will be confirmed or negatived by further observation.)

If the enemy is composed of six machines at medium height and six or twelve machines high above them, the top machines are single-seaters and the lower ones two-seater or three or four-seater day bombing machines.

The patrol leader now knows how many enemy machines he will have to deal with and he has a rough idea of the type of those machines. He will now watch the movements of the enemy machines, and these movements will support or overthrow his first deductions and will form final and conclusive evidence of the machine types.

If six or more enemy machines fly upon no regular course in formation high up along the lines either over enemy country or our own country, those six or more machines can be none other than fighters.

If a single enemy machine goes round and round and low down on a regular oblong course just over enemy

Digitized by Google

country, and with the longest leg of the course at right angles to the lines, that machine is a two-seater artillery observation machine.

If a single machine flies on a very irregular course low down, it is a single-seater machine attacking ground targets.

If a single machine is flying very high on a straight course it is a long-reconnaissance machine.

If the enemy is composed of six or twelve machines at medium height and two or three machines below them, all flying on a nearly straight course over our own country, then the low machines are photographic two-seater machines and the higher ones are single-seater fighters escorting them.

Day bombing formations fly on a regular course and consist of a formation of bombers at medium height and a formation of single-seater fighters above them. The enemy bombers will be two-seaters if the top of the fighter formation is almost as high as the friendly patrol. They will be three or four-seaters if the fighters are at medium height and the bombers low.

From this account of the individual peculiarities displayed by machines engaged upon each type of work, it will become clear how each observation made by a patrol leader builds up evidence and tells him, with very small possibility of error, the number, type, work and formation of the machines to be attacked while those machines are still in the extreme distance and only just visible.

The reasons why certain formations, and certain heights are chosen for each kind of work, will appear when a complete description has been given of both the strategical and tactical principles which apply.

As the preliminary observations with which this chapter deals are of great subsequent importance to the course of the action, it will be advisable, before leaving the subject, to summarize the looks and habits of the various kinds of formation or single machine, and to

Digitized by Google

place beside the summary the deductions which the patrol leader will make.

A formation of six or more machines flying on no definite course.	An offensive patrol of fighters.
A single machine, low down, flying on a regular oblong course with the long leg of the course at right angles to the lines and over its own territory.	A two-seater artillery observation machine.
A single machine, low down, flying a very irregular course and making dashes over our territory.	A fighter engaged in attacking ground targets.
A single machine flying very high on a straight course towards friendly territory.	A long distance reconnaissance machine.
A formation of six or more machines flying at medium height and two or three machines below them flying on a nearly straight course.	A photographic patrol of two or three two-seaters escorted by a formation of fighters.
Two large formations, one above the other, flying on a straight course.	A day bombing formation escorted by fighters. The bombers are two-seaters if all the patrol is flying high; but they are three or four-seaters if the patrol is flying low.

Two other matters must be dealt with before leaving preliminary observation. In some countries the higher commands of the air, in causing two-seater bombers to be built, are insisting that these day bombers should be capable of defending themselves, so that they may effect day bombing raids unescorted by fighters.

Possibly day bombing raids may be made in the next war without fighter escorts; but it is very improbable. For a variety of reasons which will appear later, day bombers are unable effectively to defend themselves against single-seater fighters. This

Digitized by Google

is no adverse criticism of the policy mentioned, for obviously the better the bombers are able to defend themselves the safer they will be, but the policy is noted because, otherwise, objection might be raised to the description given above of a typical day bombing formation *with* a fighter escort.

The final point to be considered in preliminary observation is the detection of layer patrols.

The difficulty in detecting the layer-formation is one of the reasons for the effectiveness of such a formation. The best that can be done here is to mention every indication which should lead a patrol leader to suspect the presence of layers.

Layer patrols are usually made up of several small formations rather than of few large ones. Thus 12 machines might fly in four layers of three each. If the distances between the layers are kept as great as they should be, it would be impossible for a patrol leader when making observation to notice the top layers at the same time as the bottom ones. He would have great difficulty in detecting them even after suspecting their presence.

It is fundamental to a layer patrol to look weaker than it is. Therefore, if three enemy machines are observed flying far over our own territory, very careful examination of the sky for machines, or for bursts of our own anti-aircraft fire above and below the three machines should be made.

The small size of a formation, especially when coupled with bold action gives, therefore, one reason to suspect reserve formations above or below.

Again, a single machine flying backwards and forwards close to the lines is behaving suspiciously if its course lies more or less parallel to the lines. It may be acting as "bait"; and any machines attacking it would be pounced upon by patrols from above immediately a light is fired from the "bait" machine or upon some other signal.

The patrol leader must make preliminary obser-

Digitized by Google

vations rapidly and he must be able to pick up machines at great distances, which is chiefly a matter of practice. Nearly all preliminary observation is done at very great distances from the enemy machines. In fact, the enemy machines are seen as specks and nothing more. It is only by their actions, and the absence or presence of bursts of anti-aircraft fire that it may be determined whether they are hostile or friendly, upon what work they are engaged, and what types of machine they are. Practised pilots can, of course, recognize machine types at distances simply by their silhouettes. But the preliminary strategic observations which have been described are conducted at distances so extreme that this faculty, however highly developed, cannot be employed.

Digitized by Google

CHAPTER IV

Attack Strategy

CONCEALMENT

In the last chapter the value of surprise in aerial warfare was emphasized and it was shown that, in order to surprise an enemy, it was necessary to know what the enemy was doing and to conceal what your own machine or formation was doing. Full details were given as to observing the enemy and as to making deductions from that observation which would furnish all the information required for a surprise attack.

In this chapter concealment will be dealt with, and then all material information showing how a surprise attack may be effected will have been given. Of course, in practice, a pilot who is contemplating making a surprise attack carries out his observations at the same time as he is taking every precaution to conceal himself, and concealment and observation have only been separated from one another here, for the sake of clearness.

It is a curious thing but, as it has been suggested already, on a day without a cloud in the sky, the air is the easiest place in the world for an airman to conceal himself in as far as other pilots are concerned. This is partly because the airman has no means of memorizing the parts of the sky he has searched with his eyes and partly because a complete sphere (as I must call it for want of a more exact term), or the maximum possible amount of space, must be examined. If a person looks for a cork on the sea he at least knows that it will be on the surface. In the air he

Digitized by Google

does not know at what level his opponent may be flying.

In order to pick up aeroplanes *from* an aeroplane with certainty, it would be necessary to be able to look everywhere at once. The sound of the engine gives away the position of an aeroplane to an anti-aircraft gunner, and even if there were no sound to assist him, a man on the ground must search only a hemisphere when looking for an aircraft, or exactly half the space that a man in the air must search.

Concealment in the air is quite differently effected from concealment on land or sea. There are no brick walls to get behind and no horizons to sail over—at least not within sight—yet concealment can be secured as positively as by a brick wall.

I have pointed out the vast size of the space which has to be watched and I have pointed out that sight (not hearing) is the only sense which the airman can rely upon for picking up another machine, but there are yet two other reasons why concealment in the air is possible.

First, the size and shape of aeroplanes themselves make concealment easy. The pilot of a small single-seater fighter could watch a large bomber from so great a distance that the single-seater would be out of sight of observers in the bomber. When the bomber appeared to the single-seater pilot as nothing more than a full stop in the sky, then there would be no possibility whatever (assuming an average of eyesight) of the single-seater being watched by observers in the bomber.

Again, if you look at an aeroplane flying above you, you see two wings outspread and a thin fuselage with another smaller spread of wings at the tail. If you look from above upon an aeroplane a very similar plan confronts the eye. But look from the front or rear, and the machine presents not a half, nor a third the area to the eye; but, in effect, about a *twentieth* the area.

Digitized by Google

Supposing a machine were diving at you, as it might if it were attacking. At a little distance you see the nose as a round dot and that is all. The machine must come very close indeed before you also can distinguish the two fine lines which are the planes. In other words, not only can one machine conceal itself from another larger machine at a distance by virtue of its smaller size, but it can approach the other in an attitude which presents a very small area to be picked out from a complete sphere of vision. (The "blind" arcs of aeroplanes may be studied from Figs. 5, A and B).

One more point before turning to the actual methods of concealment. Aeroplanes move quickly, and in the future will move far more quickly. 150 m.p.h. would not be unusual and, in the attack, a speed of 200 m.p.h. to 300 m.p.h. is sometimes registered. Therefore, two machines might, in quite normal fighting conditions, approach each other at a combined speed of 400 m.p.h. This allows machines to come to close quarters from a long distance apart, in an infinitesimal space of time.

A pilot would only have to look over the side to mark the position of a gun flash on the ground and a hostile machine that was out of sight when he began looking, could be 50 yards behind his tail streaming fire and lead before he turned his head round again!

> From a position of absolute concealment a machine may reach another in so short a time that it would require eyes much quicker than and much different from human eyes for their owner to be able to say, "I shall never be surprised in the air."

And the important point to remember is that one single-seater may surprise a two-seater more readily than it may surprise another single-seater; and it may surprise a formation more readily than a single machine.

It was the paradoxical experience of many fighting

Digitized by Google

pilots that a formation was easier to surprise than one machine, although there were more pairs of eyes on the look-out. "It is easier," says Bishop, "to surprise a formation of four or six than it is to surprise one or two."

I have laid stress on the facility with which a machine may be concealed on a perfectly fine day in the air, because, to laymen, and to those who have not fought in the air, it often seems incomprehensible that, where there are not brick walls or other opaque obstructions, concealment of an aeroplane should be possible.

I will add two examples. In the war it was common experience for a patrol leader to lead a patrol containing one novice into a formation of enemy machines and to be embroiled in what seemed to be the whole German Air Force for several minutes. Then, upon breaking off the combat, the novice would be missing. Upon arriving back at the aerodrome, however, the novice would be found to have landed safely. He got lost, he says, and, when further questioned, he replies, "No, I never saw a single enemy aeroplane."

The other example is even stronger proof of the rapidity with which things happen in the air and the difficulty of looking all ways at once. On more than one occasion our patrols, under experienced leaders, found a German machine flying along in their midst as if he were one of the patrol. Upon comparing notes afterwards it was found that no one saw the hostile machine join the patrol—it just appeared!

Surprise depends upon concealment and observation. In the air concealment and observation can be combined and this is how this may be done.

First, it must be stated that patience is necessary in order to effect a surprise. "To surprise the enemy," says Bishop, "requires a tremendous amount of patience and many failures before one is ever successful."

There will be much watching and waiting and many disappointments but, to perfect his technique in air

Digitized by Google

fighting, the pilot must be prepared, as in other arts, for a long and arduous apprenticeship. Stalking an enemy machine is trying to the sight, extremely tiring and very cold work. Half an hour or even an hour may be spent at 20,000 feet or more, watching intently a couple of specks in the distance and then the opportunity for attack may never come. But such experiences have to be borne before an understanding of this almost mystic process can be gained, and then it will be found that the process possesses a certain grim fascination of its own.

"I stalked this Rumpler," says McCudden, "for nearly an hour before I finally engaged him;" but the hour was well spent, for the enemy was shot down with a certainty which is never achieved by the unscientific fighter.

How then will the patrol leader or the single pilot begin his stalking after he has spotted an enemy machine? Assume that our pilot has observed a machine which, from its movements and height, he deduces, as explained in the last chapter, is an artillery observation machine; a two-seater with a gunner in the back seat.

The artillery machine will be low down and it will be looking out for enemy aircraft above it. Consequently, by keeping below the enemy machine, our pilot will be less likely to be noticed by it. At the same time the enemy machine is working well on the enemy side of the lines, and the final approach of our machine from below would be marked by enemy anti-aircraft fire and therefore observed by the enemy machine.

Our pilot therefore leads his patrol straight *away* from the enemy towards the sun. He climbs as he goes until he has all but lost sight of the enemy. Then he flies up and down, keeping between the sun and the enemy machine. After a few minutes he can be sure that the enemy has lost sight of him if he ever saw him.

Our pilot then watches until the enemy is on that

Digitized by Google

part of his course that leads him closest to our own territory. He then makes a final examination of the sky above the enemy machine and, judging his dive so as to engage when the enemy machine is as near our own lines as possible, our pilot puts the nose of his machine down and goes, straight from the eye of the sun, towards the enemy. What he does next will be considered under the heading of tactics.

Assume now that our pilot has observed a formation which, again applying the system outlined in the last chapter, he knows to consist of single-seater machines on offensive patrol.

With these single-seater machines great care will be necessary if a successful engagement is to be achieved. Height is essential. If the enemy machines are above our own then our machines must go home and climb hard. They must go so far home as to be out of sight of the enemy, otherwise the enemy will climb too, and, by keeping above, prevent our machines from attacking.

If the enemy patrol has been observed early and kept at a good distance away and if it does not climb, our pilot can be sure his patrol has not been observed, and he may carefully obtain sufficient height to allow him to engage rapidly.

Having obtained sufficient height our pilot will again come from the sun, or, alternatively, from the *enemy side of the lines*, and dive on his opponents.

In attacking a formation of bombers escorted by single-seaters above, our patrol can conceal itself by keeping below and at a great distance from the bombers. It cannot keep far below, however, or it would take too long to engage the enemy when the moment arrives; for obviously climbing is a slow business compared with diving.

The method of concealment from enemy machines flying above our own consists in keeping slightly in front of and below the enemy according to the type of machines being attacked. Usually there is a blind

Digitized by Google

spot below bombing (and other) machines in a *forward and downward* direction (Fig. 5).

To attempt to attack from below without possessing a store of speed, however, is never advisable unless circumstances demand an attack before there is time to gain height. If there is time to gain height the enemy single-seater escort will be the first objective and not the bombers themselves, and the process of concealment will be the same as for attacking an offensive patrol.

Methods of concealment before attacking other formations are always devised upon a similar system, and the principles of concealment may be summed up as follows:

The patrol leader must climb in a direction which will place the friendly patrol in a position from which the enemy airmen will not expect attack, or he must climb towards the sun in which direction visibility is much restricted. He must remain as far from the enemy machines as sight will allow until a few moments before the attack is to be made.

The concealment which is effected by flying below the enemy machines may be used as an emergency measure, such as when machines are flying over friendly territory and must be driven off at once. Otherwise it is always necessary strategically to get *above* the enemy. The boast in one of the Beaumont and Fletcher plays: "I've towered for victory like a falcon in the clouds; not dug for it like a mole," applies with a new force to fighting in the air.

Height is a strategic advantage of prime importance, and patrol leaders should always study to "hoard height" as McCudden used to express it.

Height allows a rapid approach to the enemy to be made and ensures that the enemy will not attack. Obviously if one machine is some distance below another it cannot suddenly engage, but must climb to the attack, which is a slow process, especially when the machine is flying near its ceiling.

Digitized by Google

Long practice is necessary before a pilot can watch another machine from a distance without losing sight of it and without allowing his presence to be discovered by going too close to it. Intense concentration is also necessary, and therefore a pilot in a single machine can most readily effect a surprise by watching from a position above friendly territory, where he need not keep quite so strict a look-out for his own safety.

In order to effect surprise over enemy territory, by attacking from an unexpected quarter, a patrol is necessary so that the leader can concentrate on his quarry while the remainder of the patrol watch for other enemy aircraft.

There are many smaller points which enter into the problem of concealment. An artillery observation machine, for example, flies on a certain course and the occupants or, at least, one of them, makes observations of shell bursts. Therefore, when they reach that part of their course from which they expect to mark the shot, it is almost certain that only one man will be watching the sky.

This and similar points, however, will occur to the pilot who practises the principles of concealment and, as they all refer to the work upon which the enemy machine is engaged, and therefore are readily understood, they need not be mentioned in detail.

Let it be remembered then, that the scientific fighter wants to avoid a rough and tumble with the enemy and desires to bring down enemy machines with certainty whenever he engages. He must be patient and watch and wait until his chance comes. He must avoid haphazard attacks and he must have his plans carefully thought out beforehand.

Digitized by Google

CHAPTER V

Attack Strategy

BALLOONS, AIRSHIPS, ESCORTS AND NIGHT WORK

THE strategy to be adopted prior to an attack upon a balloon is not very elaborate partly because, on a clear day, it is virtually impossible to effect a surprise. Surprising a balloon implies surprising the ground crew and the crews of neighbouring A.A. guns. It has been pointed out already that an observer on the ground, who has but a hemisphere of sky to search and who is directed by the sound of the aeroplane engine, can pick up a machine far more readily than an air observer.

In the balloon attack surprise in fine weather is therefore almost unattainable and it remains for the attacker so to manœuvre that he may close with his quarry before it is hauled down to the ground.

A balloon is low down and stationary and consequently it does not show up well against the ground. An essential preliminary to the attack, therefore, is to fix in the mind the exact position of the balloon on the map and to memorize all the landmarks close to the position. This memorizing corresponds to the preliminary observation which is required before attacking enemy aeroplanes. It can best be carried out by flying low down as close to the balloon as possible without coming under too heavy anti-aircraft or machine gun fire and without going over enemy territory.

After its position has been fixed in the mind it will be necessary, before the attack, to quieten suspicion

Digitized by Google

as to the objective and to gain height by climbing away from the balloon.

Then, with all the landmarks in mind, the balloon may again be approached by the attacker at a height. His intentions are not likely to be suspected until he begins to dive, and therefore it is advisable to lose height gradually at first keeping as far away as possible from the objective.

While losing height a circular or oblong course will be followed, the whole of it being at one side of and higher than the balloon. Gradually, by losing height and making wider sweeps in the course, the distance between attacker and objective will be diminished. When the distance is as small as the attacker judges to be possible without the balloon ground crew taking fright, a sudden dash, at the highest possible speed, will be made.

The balloon attack is one of the few manœuvres for which the strategic employment of clouds may be said to take a sufficiently definite shape to permit analysis. Mostly the strategical value of clouds to the air fighter has been exaggerated. Although clouds may conceal the friendly machine from the enemy machine they must, of necessity, also conceal the enemy machine from the friendly machine. They, therefore, form very imperfect cover before attacking enemy aeroplanes, and their successful use depends enormously on chance. But in attacking a balloon a different state of affairs exists and clouds undoubtedly can be put to definite strategical use.

Since a balloon keeps still there is no need for it to be watched continuously when once its position has been fixed. Our pilot may select a large cloud which, bearing in mind the direction of the wind, he judges will drift over the balloon. He can then fly round and round on top of the cloud, keeping part of his machine buried in the cloud all the time.

It is necessary thus to keep close down on the cloud in order to prevent anti-aircraft stations, which are at

Digitized by Google

a distance and which therefore possess a view over the cloud, from seeing the ma hine and giving the alarm. From this position half in and half out of the cloud distant landmarks will be watched and, when the time comes, the pilot will either dive through the cloud—if he is very positive how low it extends—or, usually better, he will dive down at one side of the cloud to the attack.

While he is circling round over the cloud the pilot should remember that a machine shows up well against a cloud background a d that hostile machines should be expected at any moment from above. The last action before diving to the attack should be to look carefully for hostile machines. Clouds may also be used effectively when there is a thin layer over the sky with only a few openings here and there.

There is yet another strategical method of attacking a balloon. In this the attacker flies very low (perhaps under 500 ft.) over friendly territory and "picks up" the balloon in the distance. He then crosses the lines still keeping very close to the ground and approaches the balloon from below. This method was originated because it was found that when an aeroplane attacked by diving, the crew were often able to haul down their balloon before the aeroplane could reach a decisive range. The low-flying attack requires but small strategical preparation, for the balloon will remain in view from the moment it is first seen to the moment of the attack.

For attacking a balloon, then, the pilot must either wait for suitable weather when the thickness, height and formation of the clouds allows a sufficient degree of both observation and concealment, or he must abandon the idea of effecting a surprise and simply manœuvre—either by the method first described or by the low-flying method—so that he comes within range of the balloon before it has been hauled down to the ground.

In the balloon attack, however, there is a subsidiary

Digitized by Google

strategy to that employed by the attacker himself. This is the strategy of the attacker's escort.

Mostly a single machine carries out the final thrust, because balloons are protected by anti-aircraft batteries and by machine guns, and, since one can do the work, there is no object (save perhaps in the low-flying method) in risking more than one machine. Moreover, if it be adequately protected against attack by hostile aeroplanes, one machine is more likely to achieve success than many machines all of which must pay attention to defence as well as to attack. In the balloon attack, then, the escort concerns itself with the safety of the attacker until he has done his work.

The strategic means employed by the escort will be the same whether clouds are being used or not, but it may be assumed that the final attack is to be made by a dive, for in the low-flying method an escort is impractical; or at least it can secure no desirable end and is more a hindrance than a help. The escort will fly high above the machine which will make the actual attack but not so high that there is any risk of losing sight of it. When the attacker dives on the balloon the escort should not follow him but should watch him. Only if the attacker becomes engaged or is about to become engaged with enemy aircraft *at a disadvantage to itself*, should the escort depart from its rôle as a looker on and descend to the rescue.

In order not to reduce the chances of the attacker in effecting his purpose the escort must be discreet. It must avoid flying in a manner which might give away the objective.

In order to make this chapter complete a few words must be said about airships and about night work.

When once seen an airship should be easy prey to a modern high performance single-seater fighter. While cruising, an airship would, of course, be easier to surprise than any other aircraft owing to its size, its low maximum speed and its sluggish manœuvre. But if it were desired to surprise an airship the same strate-

Digitized by Google

gical principles as have been described for aeroplanes would apply, and there is no need to repeat them.

Many war pilots (including, so he told me, Capt. Robinson, V.C., who accounted for one Zeppelin) regarded manœuvring for surprise when the objective was an airship as a waste of time. Airships were rarely seen by day in the last war, and it is probable that they will be even more rarely seen in the next war.

Attack strategy at night may now be mentioned. It would almost be correct to say that, at present, there is no attack strategy at night. When once the enemy has been picked up, an immediate attack is necessary and advantageous if the relative positions of the machines allow it to be made (that is if the attacker is level with and close to, or above the enemy). The actual picking up of the enemy may, however, be regarded as belonging to the province of strategy.

There are three systems in general use for advertising to our own pilots the positions of enemy machines at night. One is the directing of an ordinary searchlight or group of searchlights upon the enemy; another is the French system, already mentioned, which has been imitated in this country and tried at Bisley and which consists in using many very wide-angle beams and flooding the sky with light. Our pilots can then pick up an enemy machine as a shadow when it passes over the field of illumination. The third method, which has not yet been developed fully, is by wireless.

Strategically the pilot is required only to understand the system of location that is being employed and to use his eyes. Possibly during the next war a night attack strategy will develop every bit as complicated as the present day attack strategy, and it is not difficult to surmise the methods which will be employed. But speculation as to future strategical developments and as to the various widely-divergent theories which have been advanced, does not come within the province of this treatise.

Digitized by Google

It remains to say that the subject of attack strategy which—like all strategy—is really a kind of thought-reading, requires much study and much discussion before the insight necessary for successful air fighting can be developed.

Digitized by Google

CHAPTER VI

DEFENCE STRATEGY

CONSIDERATION has already been given to how the attacker may effect surprise, and in this chapter examination will be made of the means by which he may himself, as far as possible, avoid being surprised and of various other matters relating to defence strategy.

It has been the experience of most war pilots, to have been flying along keeping a sharp look-out and then suddenly to have heard a machine gun a few yards behind or below and to have seen holes appearing in the fabric of the planes. In other words, they have been surprised even though they were on the alert.

This ever present possibility of an enemy machine getting to close range before it is observed has been stressed already, but here it is necessary to emphasize the defensive aspect of surprise.

The single machine, as it has been observed, is frequently the most difficult to surprise; and this is probably partly on account of the psychological effect of loneliness. The pilot knows that his safety depends upon himself; he cannot comfort himself with the thought: "Well, there's Smith in the patrol—he's sure to see anything coming even if I don't."

The single pilot in a single-seater machine has a great deal to do. He has to look for a suitable enemy to attack and he has to watch for enemy machines which may intend to attack him. But he has this advantage that he has nothing else to worry him but the problems of strategy and tactics as they present

Digitized by Google

themselves. He is not required to think about where the leader of the patrol is nor must he keep continually on the alert to hold his position in the formation and not run into another machine. "I like," said Capitaine René Fonck, "complete liberty of action because it is essential to the success of my system."

It must not be thought that the single machine is defenceless. It is not. It is, in fact, more capable of strategical defence manœuvring than a patrol. But in describing the defensive strategy of the patrol, the defensive strategy of the single machine will be embraced, and therefore we may at once turn to the patrol.

First in examining this subject a few remarks are necessary on the respective duties of the patrol leader, and of other members of the patrol. Then the ground will have been cleared for generalizations. When once the principles are grasped and the decentralization of the work in big formations has been explained, the method of application for all types of aircraft and all kinds of formation will easily be understood.

It has been said already that the work of the patrol leader consists in acting as the *striker*: in finding the enemy and in deciding upon the mode and moment of attack. From the point of view of defence the leader should be relieved of all worries by his patrol. Naturally the leader will look for machines that might attack his patrol; but mainly he will concern himself with machines his patrol can attack.

In the patrol, therefore, the strategical defence work of picking up and informing the leader of the presence of enemy aircraft flying above the patrol, is essentially the work of all the pilots *except* the leader. This rule applies no matter how large is the patrol. The leader is the striker and the rest of the patrol are the defenders.

This refers, of course, only to keeping a look-out, for immediately any member of a patrol picks up an enemy machine above, he will report the fact (possibly

Digitized by Google

by the signals already described) to the patrol leader. After that the formulation of defence strategy rests with the patrol leader.

Even in a photographic patrol a similar rule applies. The leader concentrates most of his attention upon the ground and upon getting the photographs; while the rest of the patrol concentrate their attention above for hostile machines.

The psychological effect upon a pilot of being quite alone has already been remarked upon, and the effect upon the pilots in a patrol is as noticeable but tends to an opposite result. The single pilot keeps his senses braced up to the highest tension all the time, knowing that his safety is in his own keeping. The pilots in a patrol, on the other hand, are very apt to get careless; to think of nothing else but keeping their places and watching their leader.

A few of the minor details which, nevertheless, have an important bearing upon keeping watch must now be given. The pilot must be free in his seat and wear shoulder straps which, although they allow him to turn half round and look over the tail of the machine, do not permit his body to be thrown the smallest distance from the seat during the most violent manœuvres.

Smoked glasses or special lenses for preventing the glare of the sun from dazzling the eyes are not to be recommended; they usually obstruct the view more than they aid it. Goggles should be wide and allow the fullest possible field of vision. When looking towards the sun if one eye be closed and the hand held out against the sun at *arm's length*, it will be found that a distant aeroplane can be picked up anywhere in the sky except in the immediate line between sun and observer. In keeping watch the head and body must continually be turned. Reflecting mirrors and similar devices designed to allow the pilot to see behind without turning the head have been tried and found useless.

While keeping a look-out, the hemisphere above the

Digitized by Google

observer must, for defensive purposes, claim most attention. Machines can approach rapidly from above but only slowly from below. At the same time, while slightly less attention is applied to it, a watch must be kept below, for, as will be noted when tactics are being discussed, one method of attack is by diving below at some distance away from the machine and using the extra speed thus gained to zoom up underneath it.

Observation is a necessary and vital preliminary to defence strategy and, having briefly considered the details affecting it, we may now pass on to the actual strategical defence manœuvring, or in other words, to manœuvring for defence before the machines have engaged.

Already it has been said that height constitutes a strategical advantage. It constitutes an overwhelming strategical advantage; and for this reason it is usually advisable for a machine to avoid an encounter with an enemy who is far above it.

But how may the enemy be prevented from attacking if he possesses superior height?

He cannot be prevented if the two machines or two formations, enemy and friendly, are close together when the friendly machine first observes him. But so long as the enemy is observed at a distance, correct strategical manœuvring can prevent an engagement at a disadvantage to the friendly machine.

To engage an enemy at a disadvantage to yourself is generally inadvisable and may lead to serious losses; but to allow an enemy to engage you at a disadvantage to yourself will certainly lead to serious losses.

If our machine (or formation) sees an enemy which, by his actions, shows that he is observing our machine with possible intent to attack, then the need arises for prompt action to prevent the enemy from attacking while he has height in hand and for our machine to attempt to gain height.

Assume first of all that the enemy patrol is observed

Digitized by Google

(at a distance of course) on the *same level* as our patrol. Assume also that the enemy machines are known to possess better climb than our own (it is, of course, the business of fighting pilots to know approximately how well enemy machines can perform).

Now the enemy is judged by our patrol leader to have observed his patrol (otherwise the need for defensive action would not arise). He knows that, owing to his inferior rate of climb, he will not be able to get above the enemy. He can either run away to our own side of the lines or attack at once. Between these alternatives the direction of the wind will be the deciding factor.

The fight will certainly not be very successful from the friendly point of view, although the losses may be even; but usually the moral effect gained by an immediate attack warrants it in this particular instance (that is when the enemy is observed on the same level).

But suppose our patrol possesses machines with a better climb than those of the enemy. Then the stalking methods described under Attack Strategy will be employed. The friendly machines will fly away gaining height and keeping the enemy in view.

Supposing now that an enemy patrol is suddenly observed 3,000 feet above our patrol. Our patrol is at a serious disadvantage. If the enemy comes down there is a probability of greater friendly than enemy losses. What then can our patrol do?

It must fly as far as possible over friendly country, climbing all the time, and beyond that it can do no more than hope that the enemy will not attack. When once well over friendly country the enemy may think twice about following, and a climbing-match will result with both patrols well over their own territories watching each other and each attempting to gain sufficient height to make a decisive plunge.

Of course the enemy, if well led, will not permit our patrol to escape, but will dive upon it before it can go

Digitized by Google

far over its own territory. The only possible defence strategy, however, is to attempt to gain height. *Every* 100 *feet less between a friendly patrol and an enemy patrol above, reduces the advantage of the enemy.*

When an enemy patrol flies over friendly territory and is observed by our patrol which is below it and therefore strategically at a disadvantage, it is again best for our patrol to gain a margin of height before attacking. Sometimes it is advocated that our patrol should fly below the enemy and attempt to entice them down to combat.

Flying below the enemy in this manner is not only foolish, but it *never succeeds in allowing our pilots to bring down enemy machines.* Therefore, although those who do not understand air fighting and who see, from the ground, their own patrol apparently running away from the enemy, may be displeased, the patrol leader will be acting rightly by temporarily retiring if the heights of the two formations place our patrol at an initial disadvantage.

An enemy patrol flying far over our country will rarely allow itself to be enticed down into an even fight. It will cling to its height. Our machines vainly attempting to climb up below the enemy and yet to keep going forward as fast as the enemy may look satisfactory from the ground, but strategically they are playing the fool.

The defending aeroplanes for England during the war were much hampered in their action by the knowledge that, in the daylight, their movements were being watched by thousands of people who understood nothing at all about the strategy of air fighting. The pilots felt forced to fly straight up to the enemy machines without the smallest strategical manœuvring. Otherwise they imagined that people on the ground might think they were shirking their work. The impression was a natural one and does the pilots no discredit, but it explains why heavily laden bombers

Digitized by Google

more than once made successful raids and actually shot down some of our own fighters.

To the calm strategist unhampered by what those on the ground were thinking, those bombing machines should have been dead meat. The pilot must learn not to worry about what ground observers say or think. Successful results in the air soon change their opinions, and successful results are only possible by full attention to the strategical problems.

And now for a note of warning. In the defence there is one fatal move ; a move which invites disaster and yet which the novice finds it hard to resist.

It will be observed that, in all the examples of defence strategy given above, it has been insisted that the friendly machines should *climb*. Not once was it said that they should dive. To dive away from an enemy is certain death if the enemy understands his work.

When the novice suddenly hears a machine gun behind him, his first instinct is to put the nose of his machine down and to gain speed. When a large patrol of enemy machines is suddenly observed above our patrol the tendency for the inexperienced leader is to dive towards friendly country. That tendency must be fought against by meditation and practice. To lose height during strategical defence manœuvring (except when acting as "bait") is a grave error. Every foot of height is valuable and adds to the safety of the patrol. To lose height takes almost no time ; to gain height takes a long time.

In defence strategy therefore it is essential that the idea of gaining safety be disassociated completely from that of gaining speed and associated solely with that of gaining height.

To sum up : defence strategy consists in so manœuvring that height shall be gained before the enemy (who holds the advantage of position) engages. Defence strategy *never* consists in losing height.

Before closing these remarks on defence strategy,

Digitized by Google

the theory that no machine should ever be on the defensive in the air must be refuted. It was a theory held by many officers during the war. "The best means of defence is offence," they said, and they had every excuse for imagining that aeroplanes should always be on the offensive because they possessed no experience of air fighting.

Had those officers who held that aeroplanes should never be on the defensive understood the strategy of air fighting, they would have understood also why, in the air, the best means of defence is never offence; why, when defensive strategy is necessary it is impossible to use offensive measures.

On the ground it may be a sound policy for attack to be followed by counter-attack. But no one can counter-attack if they cannot get to grips with the enemy. Frequently it has been pointed out that, in the air, height is a strategical advantage. If the enemy is 5,000 feet above the friendly machines and if the enemy dives to the attack, no power on earth can make the friendly machines counter-attack. They must merely wait and be shot at and seize the fleeting opportunity that may offer to return fire while the enemy is at the lowest part of his dive and zoom. Under such circumstances successful action is almost impossible.

It is on account of the strategical value of height and the tactical value of speed, that war in the air is so largely influenced by the aeroplane designer's brains. It is on the same account that the quality of fighting aircraft tells more than the quantity.

Digitized by Google

CHAPTER VII

Attack Tactics

GENERAL

Having given consideration to the problems of strategy, it will now be possible to proceed to the problems of the actual fighting—as the machines are in the act of engaging and while they are engaged—this part is tactical.

In this chapter general observations on air tactics will be made, and in following chapters detailed descriptions of the best methods to be employed when attacking the various kinds of machine will be given.

It already has been explained that height constitutes the greatest strategical advantage. A machine cannot attack another one unless it is as high as or higher than that other one. For this reason the *first* manœuvre in attack tactics is usually a dive.

After the dive, during the latter part of which the pilot will open fire, a zoom is used to retrieve lost height and to maintain the initial strategical advantage.

But when both attacker and attacked are on the same level no zoom is possible, because there is no excess of speed, and the manœuvring then has for its object the attainment and retention of a definite tactical position (*e.g.*, behind the other machine).

All attack tactics falls naturally into one of these two groups: the dive and zoom; or the maintained position.

If a good strategic position has been successfully obtained by our machine, then it will dive on the enemy at the moment when it thinks the greatest chance

Digitized by Google

for a surprise offers. Usually a long dive has to be completed before arriving at close quarters, and it is necessary of course to point the machine, during the dive, some distance ahead of the enemy to allow for his movement.

After firing until the closest practicable range has been reached, a zoom is made which should carry the friendly machine out of effective range of the enemy guns. Therefore, when using this tactical method our machines can retire to a position of comparative safety between each attempt upon the enemy.

When applying the other tactical method, in which both machines cling together during the fight, no escape is possible in the event of jammed guns, a "missing" engine or a wounded pilot. It will therefore be seen that the dive and climb method is the safer of the two and also it gives as good a chance of bringing down the enemy if it is scientifically employed.

But there are matters other than strategical position which may have a bearing upon whether or no "infighting" is advisable. One of these is the capabilities of the machines. Our own pilots will know the type of machines they are attacking and they will know where, in performance and manœuvre, those machines excel and where they fail. Thus, if the enemy machine is known to lack the power of manœuvre at a great height, and if the engagement takes place at a great height where our own machines are still well under control, then the leader of the friendly patrol might decide, with every justification, to close with the enemy and to stay closed until a decisive result had been obtained.

The control of a machine at a great height is always less absolute than when near the ground; but frequently the machine which is the more lightly loaded per square foot of wing surface is better at manœuvring at a height than a heavily-loaded machine. This, it must be added, is by no means a rule; but the infor-

Digitized by Google

mation should afford some indication of a machine's qualities when the opportunity for actual test is not available.

But whether in-fighting or out-fighting be decided upon, and, as it has been shown, this depends upon position and machine types, there is a right way and a wrong way to manœuvre.

In most machines there is some arc, or perhaps it should be called a spherical sector, in which, owing to the position of the planes or tail plane or fuselage, fire cannot be directed. Naturally the attacker gains an advantage by approaching the enemy in the direction of one of these "blind spots" if he is able to do so. The essence of attack tactics is so to place the machine as to be able to shoot without being shot at in return. Or, if that is impossible, so to place the machine as to be able to shoot without allowing the enemy to return fire under equally advantageous conditions.

It will therefore be seen that the pilot must know exactly where are the "blind spots" in every enemy machine; he should know how extensive are the fields of fire and of observation in every enemy machine. Most aeroplanes are made so that the pilot and observer can see either up or down. No aeroplane has yet been built, or ever will be built (unless some invisible material for wing structures and covering becomes available) in which there is unrestricted view both above and below (Fig. 5, A and B).

The "pusher" machine was produced with the express purpose of enabling the pilot to have a good field of view; and it certainly gave him a good field of view in the direction it was of least use to him—forward. A "pusher" is so vulnerable from behind that it is surprising that machines of this type did as well as they did during the period they were used in the war. But pushers cannot evade the common trouble; they can only give a very good view upwards and forwards, and downwards and forwards. Behind, either the view is partly restricted both upwards and

Digitized by Google

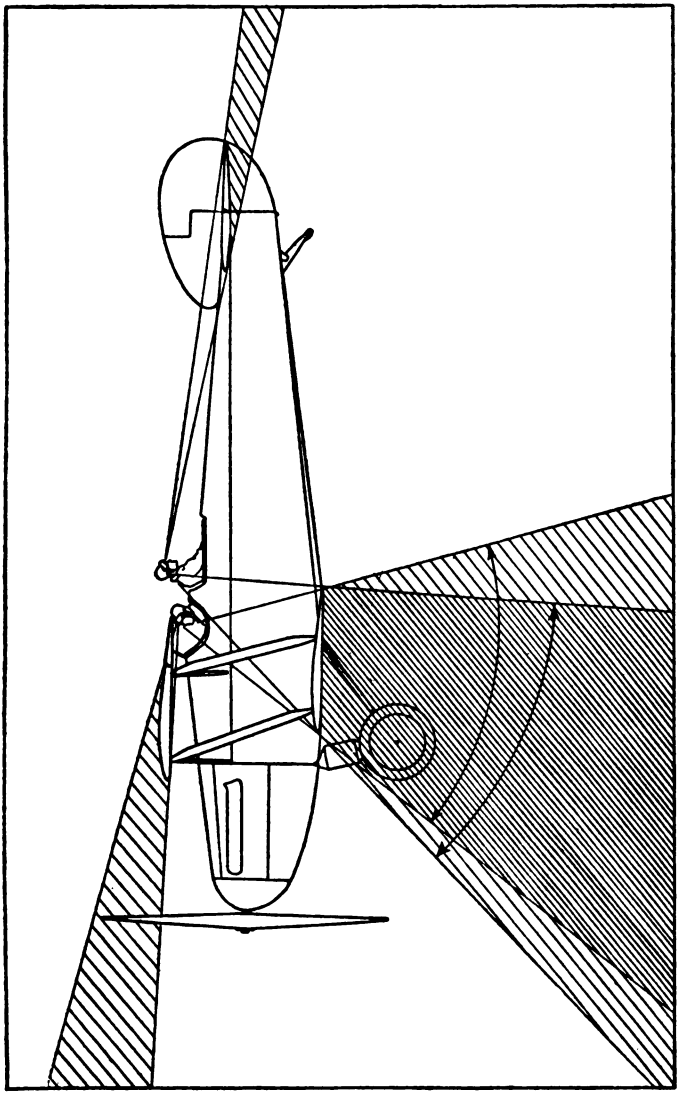


FIG. 5A. Blind areas: Two-seater. Side elevation. The darkly shaded part is blind to both pilot and observer. The fuselage causes an additional narrow blind area underneath (not shown).

Digitized by Google

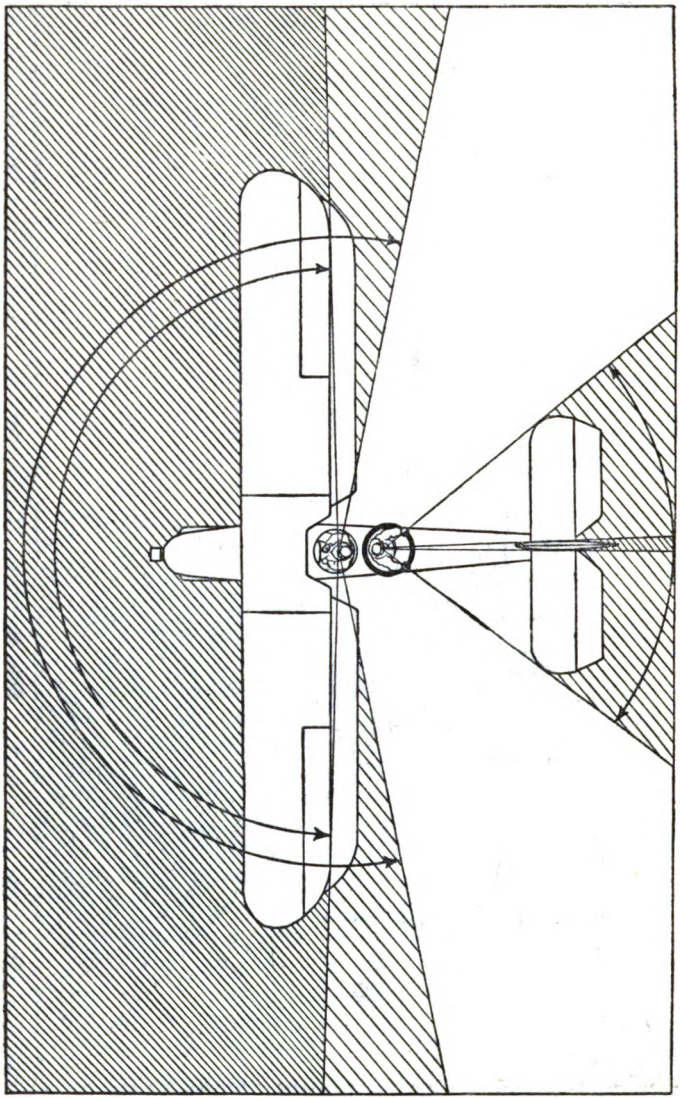


FIG. 5B. Blind areas: Two-seater. Plan view.

Digitized by Google

downwards or else it is wholly restricted in one direction only.

This, then, is a general rule which holds for every machine. The view will be seriously restricted in the upper hemisphere or the lower, and the pilot, when he is engaged in attack tactics, will bear this main point always in mind and act accordingly.

If the view from the enemy machine is bad below it, it will be the work of the friendly machine to pass frequently underneath the enemy and to execute manœuvres (which will be mentioned later) which will tend to confuse the enemy by preventing him from seeing and shooting.

If the view of the enemy is restricted above, then it will be the friendly machine's aim to remain above during the entire fight.

It will be observed that these remarks are general and they do not lessen the need for giving full attention to the finer distinctions. All very close range work should conform to an *exact* and detailed tactical plan; but it is always well to bear in mind the broad characteristics of the enemy machine and the direction, up or down, in which his view is more restricted is one of these.

And now a description will be given of the fields of fire of the various types of machine. These will vary as alterations occur in design; but these alterations, whatever they may be, will not in the least affect the principles of tactical work, and therefore the fields of fire of the three main types as they exist at present will be explained.

The single-seater fighter possesses two or four fixed machine-guns firing directly in the line of flight. (I am excluding here specialized types such as those fitted for "upward shooting.") The pilot, therefore, aims his machine in order to aim his guns. It is clear that the single-seater fighter is unable to return fire in any other direction but straight ahead, and tactically the single-seater may be ap-

Digitized by Google

proached in perfect safety from any direction except straight in front of it. This would seem to make the single-seater more vulnerable than a two-seater, and probably gave rise to the expression "battle-plane" found so frequently in the press with the meaning of a large machine with many guns.

In actual fact the larger the machine, the less right has it to the title "battle-plane," for the less performance it will have and less manœuvre. *It is by performance and manœuvre as much as by gun-fire that fights in the air are won.*

Next take the two-seater (Fig. 6, A and B). The two-seater possesses one or two fixed guns firing straight forward in the line of flight in exactly the same way as the single-seater. But it also possesses a back gun mounted so that it may be trained by the observer or gunner in any direction except down through the fuselage.

The back gun, as it has been suggested already, cannot actually fire in all directions in which it can be pointed owing to the presence of parts of the aeroplane such as the planes, the struts and the bracing wires. Every direction is safe for an attacking machine, therefore, in which a part of the two-seater interposes itself between the observer's gun and the attacker.

Under the tail of a two-seater the attacker himself and his engine will be safe from fire from the observer's gun, as the observer would have to shoot through his own tail plane in order to return fire.

The attacker will also be safe if he approaches a two-seater from underneath and in front of it. The lower planes of the two-seater obstruct the view (and the gun-fire) of the observer and pilot.

An attack may also be made from in front and on the same level as the two-seater. So long as the attacker does not allow the two-seater pilot to point the nose of his machine directly at him the attacker will be safe.

More detailed examination of two-seater blind spots

Digitized by Google

FIG. 6A. Arcs of fire: Two-seater. Side elevation. Fire in a vertical downward direction is prevented, of course, by the fuselage.

Digitized by Google

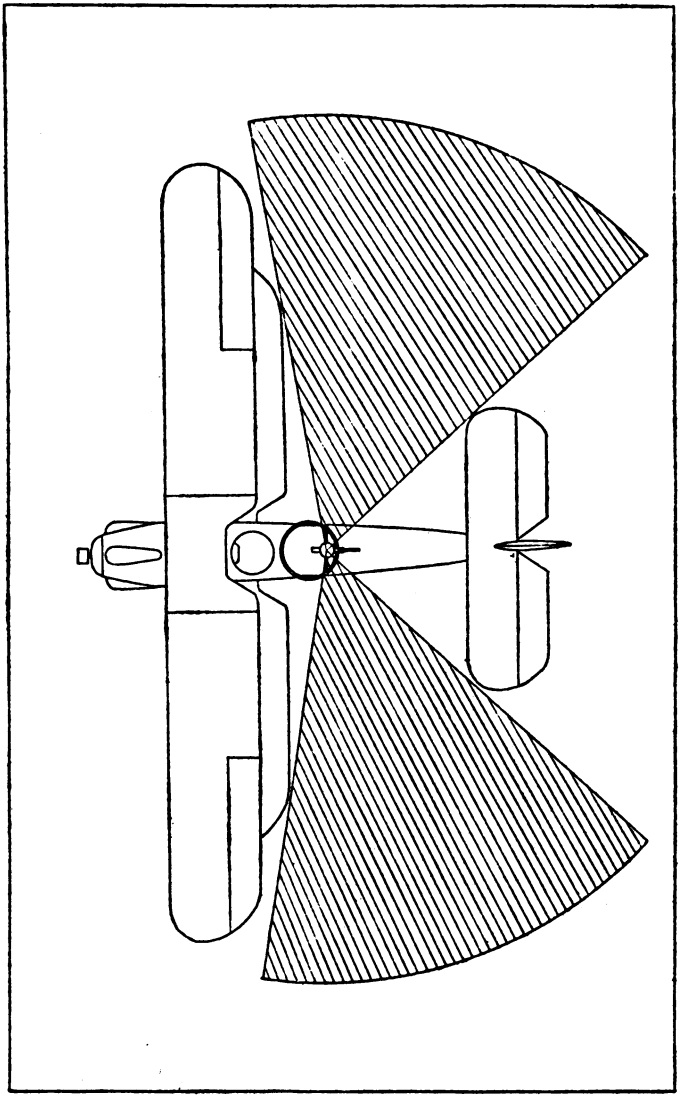


FIG. 6B. Arcs of Fire: Two-seater. Plan view.

Digitized by Google

will be left for the chapter dealing with single-seater *versus* two-seater.

In the bombing machine (Fig. 7, A and B) there are few blind spots. In some bombers indeed fire could be opened in almost any direction. Usually however from forward and below an attacker is safe. He is often safe, if the bomber has a large biplane tail, in going close up to the tail. But this is a matter where intimate knowledge of machine designs comes in, for machines have been built with a special gunner's cockpit in the extreme tail, giving the gunner a clear field of fire behind.

From a general survey of attack tactics two main points emerge; attack tactics may consist in in-fighting or in dive and zoom, and the manœuvring of the attacker may be executed in the main either above or below the enemy machine. The dive and zoom attack is usually better when the enemy machines hold a superiority in performance and manœuvre over the attackers, and the in-fighting is better if the manœuvre of the enemy machines is known to be inferior. The close range attacks will be carried out mainly from above the enemy machine if its view and field of fire are more restricted in an upward direction.

It will be understood that the positions from which the close range bursts of fire are directed are separate from the *main* tactical scheme whether in-fighting or dive and zoom. Exactly why this is so may not be very evident at present, but the explanation will appear as the subject of tactics is more fully examined.

A few words must be added about the actual flying of the attacking aeroplane.

In manœuvring harsh and rapid movements of the controls reduce speed and set up higher stresses in the machine than do gentle movements. It is commonly said by pilots that a good fighting pilot need not be able to fly well: no greater mistake could be made. The better the pilot the more chance, other things being equal, he will own in a fight.

Digitized by Google

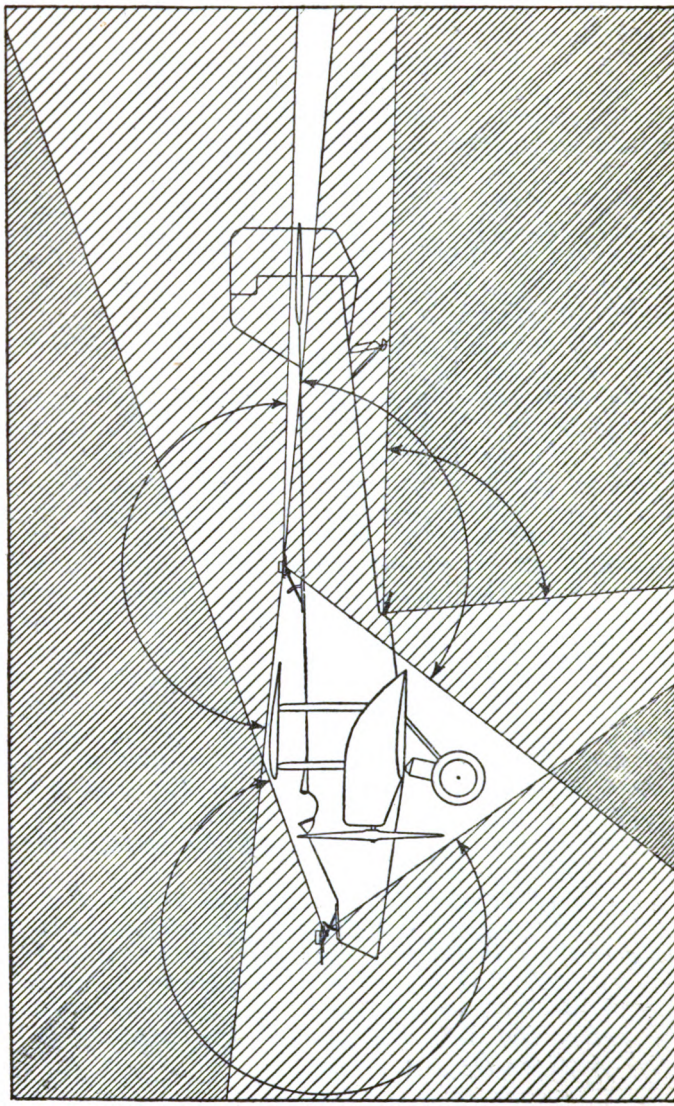


FIG. 7A. Arcs of Fire : Twin-engined Bomber. Side elevation.

Digitized by Google

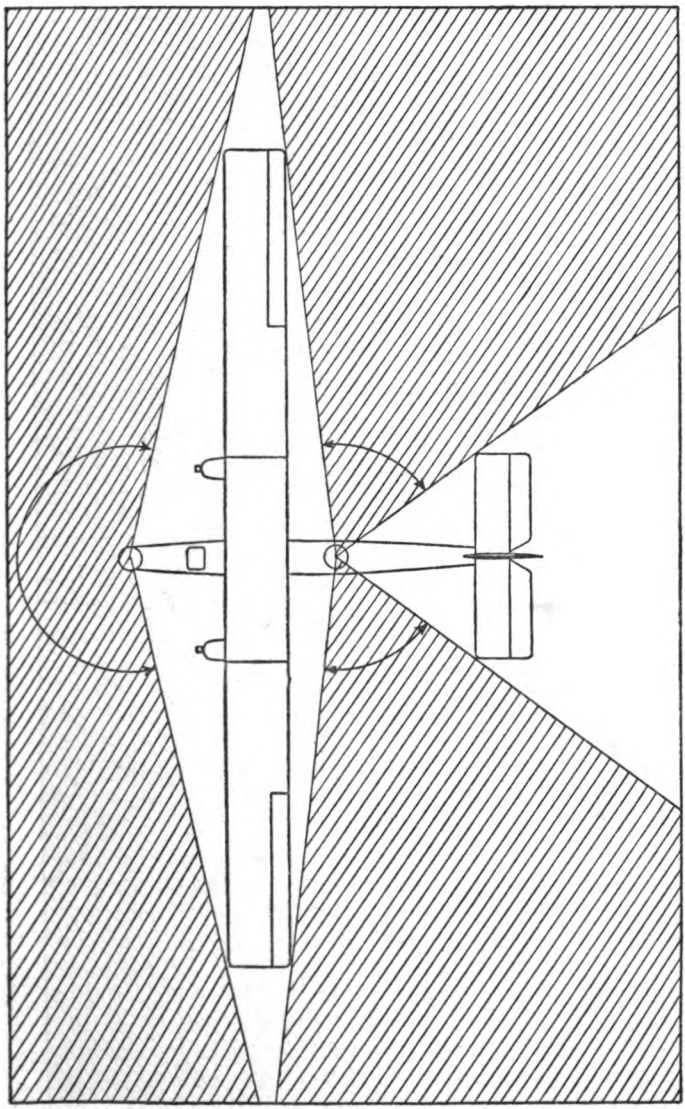


FIG. 7B. Arcs of fire : Twin-engined Bomber. Plan view.

Digitized by Google

Speed is often valuable and good piloting is required in order to obtain the highest possible speed. Thus, if two machines of identical type, as frequently happens in practising, are chasing each other round in circles the better pilot will attain a firing position first because his use of the controls will give his machine, in effect, a superior performance to the other one—he will turn more quickly.

In fighting, a smooth and gentle control should sedulously be cultivated for tactical purposes. This reduces the strains on the machine (an important point when wires, struts and spars may be shot through) and also improves its performance. By smooth and gentle control slowness of manœuvre is not to be inferred. All pressures on the control stick should be applied progressively but, when necessary, the control stick may be rapidly accelerated in order to obtain a quick answer from the machine.

There are moments when, perhaps, a harsh movement is necessary (for example, when, for some reason, it is desired to reduce the speed of the machine); but such moments are rare and in the main care should be exercised to obtain the maximum skill in piloting possible under any given circumstances.

The general points in attack tactics have now been touched upon, and the next step will be to proceed to the particular, and to dissect and lay out for inspection every twist and turn aeroplanes may make when fighting in the air.

Digitized by Google

CHAPTER VIII

Attack Tactics

SINGLE-SEATER *versus* SINGLE-SEATER

The explanations of air tactics in both attack and defence will be given as far as possible, progressively. The simplest problems will first be examined, and, when those have been thoroughly explored, attention will be directed towards the more involved problems.

Thus the tactics of one single-seater fighter against another will be taken first, and in following chapters the complications which arise when attacking multi-seater machines, when attacking formations, and when attacking *in* formation will be considered.

Assume that a single pilot is about to attack a single enemy pilot. Both pilots are flying single-seater fighters. Now, as explained in the last chapter, there are two tactical methods; one is the dive and zoom method, the other is the "in-fighting" method. Let the dive and zoom method be described first.

The enemy has been seen and watched, as described in the chapters on strategy, until our pilot has gained a satisfactory position above the enemy and with his machine between the sun and the enemy machine. He is at a great distance away. Our pilot must decide when the exact moment for attack has arrived. This will be determined according to the strength and direction of the wind and the state of enemy air activity. If the wind is unfavourable the attack will be made when the enemy is passing close to friendly territory. If the wind is favourable the attack may be made when the enemy is far over his

Digitized by Google

own territory. The enemy is less likely to expect attack when far over his own territory; but too much importance must not be attached to these points. The decision as to the moment of attack is as much a

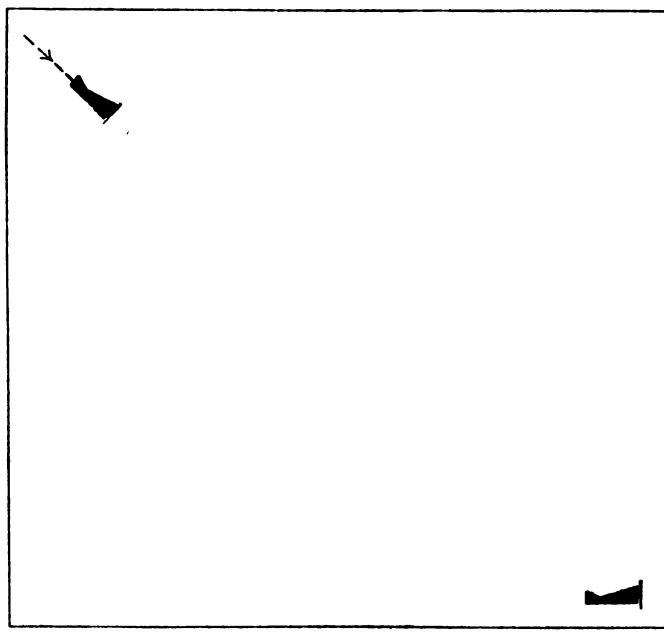


FIG. 8A. The Attack. Single-seater *v.* Single-seater. The dive, during which a burst of fire is being delivered.

strategical matter as tactical and is therefore equally dependent upon the conditions outlined in the chapter on Attack Strategy.

Let it now be imagined that the suitable moment has arrived. The pilot throttles down his engine, but probably he does not close the throttle completely, and he puts the nose of his machine down towards an imaginary point in front of the enemy. It is usually

Digitized by Google

better thus to allow for the enemy's speed than to dive straight at him and alter course during the dive, for the controls become stiffer and stiffer and the manœuvrability of the machine decreases as the speed increases.

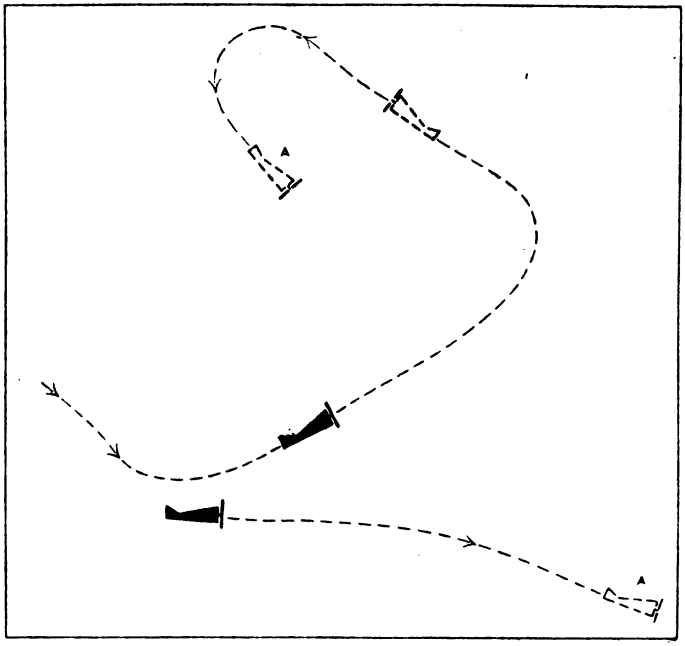


FIG. 8B. The Attack. Single-seater *v.* Single-seater. The turning zoom after delivery of attack. At the moment depicted the quarry may pull up and obtain a short burst of fire. If quarry dives away positions A A are reached.

The dive should not be too steep—nor will it be if the initial correct strategical position (at a long distance from the enemy) has been adopted.

During the dive the pilot will watch the enemy very closely. If the enemy continues to fly perfectly straight, then it is fairly certain that the attacker has

Digitized by Google

not been observed. It is then essential that the attacker should withhold fire. If he opens fire too early he does nothing more than give warning of his approach. Therefore fire should be withheld until a position at fairly close range has been reached.

At not more than 200 yards range fire may be opened (Fig. 8, A). Owing to the high speed of the attacker the burst of fire will not be a long one, and the two machines will be at 50 yards range in a very short space of time (3 seconds or less). The attacker should keep the triggers pressed and the sights on the enemy until the last possible moment, and then he should pull upwards gently, *turning at the same time* (Fig. 8, B.)

During this zoom the attacker should look over the side of his machine at the enemy and watch his movements. If the enemy has been hit the effects may be noticeable, and if he has not been hit the pilot, by seeing what is happening, will be ready to counter any defensive manœuvres in good time.

One of these defensive manœuvres might be as follows: The enemy, after turning sharply during the shooting (and being followed on the turn by the attacker of course) might, as the attacker passes overhead (Fig. 8, B) pull the nose of his machine steeply upwards and obtain a short burst of fire.

To circumvent this the attacker has already, as described, begun a turn, and directly he sees the enemy's intention he will turn more sharply. A dive followed by a straight zoom lays the attacker open to a good shot from the enemy during the first part of the zoom. That is why, immediately after the dive, a turn should always be begun. The enemy's chance is then of but a fraction of a second's duration owing to the high speed of the attacker, which has the effect of rapidly increasing the range.

If the enemy, upon being attacked, simply keeps straight and begins to dive; then, after the first dive and turning zoom have been accomplished, the attacker

Digitized by Google

must complete 360 degrees of the turn and dive again; afterwards repeating the process until his shots take effect.

If the enemy spirals downwards the attacker must dive on him as frequently as possible and, during the time he is shooting, follow the turns of his opponent's spiral. In other words, the movements of the enemy must be followed while the attacker is actually shooting, and the diving and zooming must be repeated until success has been achieved.

If the enemy, upon being attacked, at once goes into a spin it is a mistake for the attacker to deduce that his shots have taken effect. Spinning may be used as a means of escape, and the attacker should follow the enemy in a dive, making turns when necessary and always keeping above the enemy.

How low an enemy may be followed depends upon conditions of wind, enemy aerial activity, amount of petrol and running of the engine, and therefore this point can only be decided by the attacking pilot himself according to individual conditions.

Now, having examined the course of a surprise attack, let it be assumed that, during the early part of the dive of attack, the enemy sees the attacker. The enemy will either dive or spin down or else he will turn and point his machine in the opposite direction to that of the attacker. If the enemy is flying in a northerly direction and the attacker is diving on its tail in a northerly direction, the enemy, after noting the situation, would turn and fly in a southerly direction so that the attacker, if he continued his dive, would pass over the top of the enemy; both of them going in opposite directions.

What, in these circumstances, must the attacker do? He must continue his dive until he has passed over the enemy and can see him by looking downwards and backwards over his shoulder. Then a gentle twist or an Immelman turn will immediately put the attacker once again behind the enemy. If the

Digitized by Google

enemy turns again, the same manœuvre must be repeated.

It is essential that the attacker, having started his dive, should come to close range by some means or other. If the enemy dives steeply the attacker must dive more steeply, and open his engine until he approaches the enemy at a reasonable rate.

The dive and zoom method may also be used when

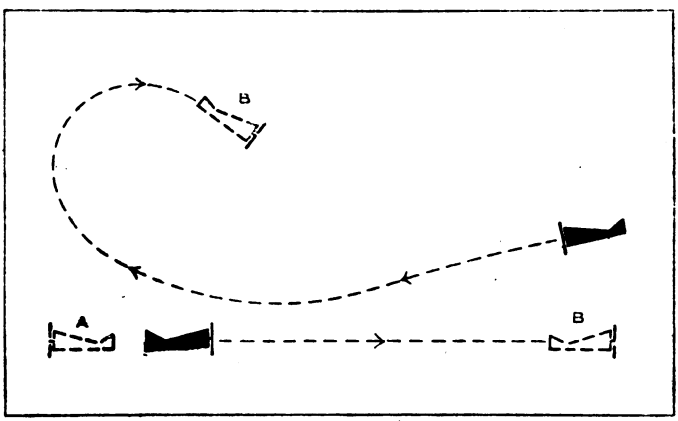


FIG. 9. Attack from the front. Single-seater *v.* Single-seater. The latter part of attacker's dive places him in arc of view blocked out by enemy's top plane. If enemy turns, placing his machine as at A, attacker retains a good firing position. If enemy does not turn, an Immelman turn brings attacker and attacked as at B B.

attacking the enemy from the front, or even from below. When attacking an enemy from the front (Fig. 9) the dive must usually be much less steep than when attacking from the rear, and therefore the strategic position must be chosen so that the difference in height between the two machines is not great. Many machines, as has been made clear in former diagrams, have a blind spot in a forward and slightly upward direction. The top plane in a biplane or the plane in a parasol monoplane is usually close to the

Digitized by Google

pilot's eyes, and this naturally blots out a large arc of the sky. The direction of this blind spot provides one reason why the attacker's dive must not be steep when approaching his quarry from the front, and the other reason is that, since the machines are approaching each other, the combined speeds must be kept as low as possible or insufficient length of time is available for shooting.

Under the best conditions and with the best judgment the length of the burst of fire in the " head on " method is extremely short ; but in spite of this the method is a good one. The single-seater pilot does not expect to be attacked from the front, and therefore it is usually possible to reach close range before the enemy has seen the attacker. Moreover, when the single-seater pilot hears a machine gun close to him his immediate instinct is to turn, and if our pilot is attacking from the front, and the enemy, not knowing where his attacker is, and in obedience to that instinct, turns, our pilot automatically falls into an ideal position behind the enemy.

While flying on the Somme Front I was, on one occasion, attacked from the front. The enemy had chosen his position correctly so that the top plane of my machine prevented me from seeing him. And although I manœuvred as rapidly as possible without losing height, I failed to pick up my attacker and I heard the sound of his gun becoming swiftly louder and louder without being able to counter his tactics by suitable defensive manœuvres. On this occasion my machine was badly damaged by the shots from my opponent's guns, which damage formed an indictment of my fighting ability. For McCudden was right in thinking that, if he manœuvres correctly after the fight has been joined, a pilot should never allow many holes to be made in his machine. Safety should not be, as it was in the encounter I have described, dependent upon luck, but upon skill.

The attack from the front is suitable against machines

Digitized by Google

with the top plane so placed as to create a blind spot forward and upward. Even if the plane is placed exactly level with the pilot's eyes this blind spot will be sufficiently extensive to serve the attacker's purpose.

It was mentioned above that the dive and zoom method may be used to attack an enemy from *below*, and this may have appeared somewhat paradoxical, for how, it might be asked, can an attack be made from below when the very fact that a dive is used

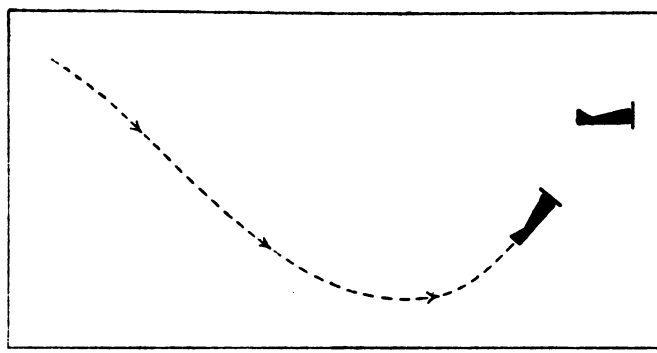


FIG. 10. Attack from below. Single-seater *v.* Single-seater.

demands that the attacker be above his enemy? The method of attacking from below by the dive and zoom method is this: Our pilot will start from his position of strategical superiority above the enemy and will dive, not *at* the enemy, but at four or five hundred yards, either in front or behind or to one side of him. Having dived below the enemy and having accumulated a great store of speed on the dive, our pilot will, so to speak, stand his aeroplane on its tail (making the manœuvre gently so as not to lose speed unnecessarily) and approach the enemy from below (Fig. 10).

This method of attack from below is extremely useful against certain classes of machines. Against a

Digitized by Google

single-seater it cannot generally be advised unless the attacking pilot is quite positive that his machine possesses a comfortable reserve of performance both in climb and speed over the enemy machine. The reason for the unsatisfactoriness of attack from below against an evenly-matched machine is that, during the zoom upwards while shooting at the underside of the enemy machine, much of the speed gained during the preliminary dive is dissipated, and therefore the position of strategical superiority above the enemy cannot be regained immediately.

When attacking by the dive and zoom method the pilot must of course follow with his machine all movements of the enemy aeroplane while he is actually shooting.

The dive and zoom method, if correctly carried out, should dispose of the enemy on the first dive. Few pilots are sufficiently accurate shots to achieve success on the first dive, however, and sometimes the diving is continued in successive stoops until the extra height of the attacker is lost and the combat is decided by a bout of in-fighting.

When diving on an enemy the speed must not be permitted to become excessive. Above a certain speed, which varies with the type of aeroplane, the controls become stiff, and it becomes dangerous to make a sudden manœuvre. The speed should be kept down sufficiently to allow enough freedom of manœuvre to follow the enemy's movements. The exact speed at which the approach should be made, therefore, depends upon the individual machine. This much only may be said, the speed of approach should be *as fast as possible* consistent with a reasonable power of manœuvre. Of course if the enemy tries to escape by diving our pilot must follow entirely regardless of how fast he is called upon to go.

For purposes of in-fighting, when two single-seater machines, both on the same or nearly the same level, join combat, each pilot is required to attempt to point his

Digitized by Google

machine (and therefore his guns) at the other. The natural result is a circular chase. A takes up a position close behind B's tail. B turns immediately to avoid A's fire and to bring his own guns into action. A follows B on the turn, and the two machines chase round and round, sometimes level and sometimes in a series of Immelman turns, until one, owing to superiority of performance or the skill of its pilot, places itself on the tail of the other.

Assume that a circular chase has resulted in our pilot attaining a position of tactical superiority behind the tail of the enemy. The enemy will immediately perform some violent manœuvre to shake him off. He may suddenly change the direction of his turn. Then our pilot must follow suit and a circular chase in the opposite direction will result.

Again our pilot will gain a favourable position, and this time the enemy will half-roll in an attempt to escape. Our pilot will half-roll as well and regain his position behind the enemy's tail. The enemy may, on the other hand, put his machine into a spin. Our pilot should not spin also, for by so doing he would lose sight of the enemy for more or less long periods at the very moment when he ought to watch the enemy intently. If the enemy attempts to escape by spinning, our pilot must dive in pursuit and wait until the enemy flattens out in order to renew his attack. A machine in a spin presents a very difficult target, and it is usually a waste of ammunition to shoot at it while it is actually spinning. The most favourable moment to renew the attack will occur as the enemy *is in process of flattening out* his machine. While the enemy is spinning away our pilot must remember to keep above him the whole time in order not to jeopardize his strategical superiority and in order to be ready to renew the attack when a suitable moment presents itself. It must be emphasized that, while in the act of straightening out from a spin, a machine is exceedingly vulnerable.

Digitized by Google

Spinning was at one time used as a blind to the attacker, with the object of letting him think he had been successful and that his shots had taken effect upon the pilot. But the attacker, when circumstances permit, always should follow his quarry if it goes into a spin and not assume that he has shot the pilot.

In all kinds of in-fighting the performance and manœuvrability of the machine count very forcibly. Good piloting is also necessary for victory.

Single-seater matched against single-seater is a kind of air fight which occurs very frequently. This duel of the air, when one man is pitted against another, is an exciting form of fighting. For a long time the manœuvring may continue and, so close do the machines pass and repass, that each pilot is able frequently to see as much of the face of his opponent as is exposed from flying helmet and goggles. This closeness assists in lending to the pilots taking part in an air duel, a peculiar exhilaration.

Digitized by Google

CHAPTER IX

Attack Tactics

ONE SINGLE-SEATER *v.* FORMATION OF SINGLE-SEATERS

In order that one single-seater shall gain a victory over a formation of single-seaters, it is necessary either to effect a surprise or to establish, during the first second of the combat, an unquestionable moral superiority. It is obvious that, unless he produces confusion or fear or uncertainty in the pilots of the enemy formation, the single pilot would stand a very poor chance of getting home safely—much less of bringing down enemy aircraft. Even if the single pilot were much more skilful than the pilots in the formation, and if the formation consisted of only four or five machines, he would not get away safely unless, to some extent, he had disorganized the enemy patrol. When the machines on both sides possess about an equal performance, therefore, the single pilot should lay his plans very carefully before he should tackle unaided a formation of enemy machines.

Assuming that our pilot understands his work, however, the attack against a patrol (no matter how large) need not be too hazardous a proceeding. So long as, between engagements, the single machine can easily retain a position of strategical superiority above the enemy patrol, the risks run on attacking a patrol are but slightly more serious than are the risks run in attacking a single opponent. But our pilot would not, except under special circumstances, be justified in attacking from the same level as the enemy patrol.

The relative positions of the machines may be put

Digitized by Google

thus: If the single machine is well above the patrol, his strategical advantage in height outweighs the enemies' advantage in numbers. On the level, the enemies' advantage in numbers gives them a great superiority in fighting strength, and the single machine is at a big disadvantage. It is possible for it to attack, however, under conditions that will appear later.

First, examination will be made of the tactics to be employed by one single-seater when attacking a formation of twelve enemy aeroplanes from a position of strategical superiority above the enemy.

Assume that the strategical manœuvres, as described in the chapters on that subject, have been completed and that the moment has arrived when the single-seater pilot is confident that he is not being observed. (For surprise will be aimed at, especially as 12 machines are more readily surprised than one machine according to the authority already quoted of fighting pilots. It is at least certain that a large number of machines is every bit as easily surprised as one machine).

Our pilot is satisfied that the enemy does not suspect his presence. His next work is to choose his quarry. *Unquestionably the leader of the patrol is the best machine to attack* when surprise is being used.

The leader probably leaves the watching for hostile aircraft to the other members of his patrol, he, personally, is looking more frequently down and in front than up and at the back. Besides this, the leader represents the point of focus of the patrol and, if our pilot succeeds in bringing the leader down, the whole patrol is bound to suffer momentary disorganization and the chance may then offer for further execution.

Against engaging the leader of the patrol of 12 in the surprise attack, it may be said that immediately the presence of the attacker is noted, eleven machines will turn their guns upon him. But attacking the patrol leader is only advocated when a surprise is being effected, and then the attacker should have disposed of the leader before the eleven machines

Digitized by Google

have time to realize his presence, make certain of which side he is on, and take sufficiently careful aim for their fire to be dangerous. Pilots have succeeded in bringing down the leader of a large patrol without having a single shot fired in return.

In the surprise attack on a patrol, then, the leader is emphatically the right machine to choose as the objective. The attack itself must partake of the qualities of the surprise attack in single-seater *v.* single-seater. Our machine will dive upon the tail of the enemy and will withhold fire until the last possible moment. A short, very carefully aimed burst will be delivered, and our machine will instantly zoom up again turning at the same time and the pilot observing the manœuvres of the other machines.

If the patrol leader, upon finding himself attacked, dives or spins away, the attacker, unlike in single-seater *v.* single-seater, must make no attempt to follow. The attacker must simply deliver his burst with all possible accuracy and at the closest range, and then get above the patrol again. While he is zooming up he must turn as sharply as possible consistent with not reducing his speed unnecessarily, in order to present a difficult target to the remainder of the patrol should they obtain a sight in time. Alternatively he may half-loop and half-roll out at the top. The half-roll may be a whip or slow half-roll. This alternative method, however, does not permit the quarry to be kept under observation quite as well as does the zooming turn.

Assume now that the first stroke has been successful. As the attacker is on his upward zoom, he sees the leader's machine on fire or falling with a wing broken. The patrol will then be slightly disorganized and demoralized, and an immediate attack should be launched upon another machine.

The choice of the second machine to attack is determined by the length of time taken to reach it. The sooner the second attack is launched after a

Digitized by Google

successful opening, the more chance there is of obtaining a second victory; for the effect of demoralization will not have had time to wear off. The second quarry will therefore be *the nearest enemy machine.*

The average pilot of course will not succeed in bringing down two machines of a large patrol, although expert pilots have brought down three or four. Nevertheless the second attack should be made, for it accentuates the confusion in the patrol and ensures a comparatively safe retreat for the single machine.

Assume that the two attacks have been made. The single machine then retrieves as much of its height as possible, and retreats to a position of safety well over friendly territory. *It climbs all the way back.* When attacking a formation it is essential that the first stroke should be dazzlingly swift, and that it should be successful. The pilot who is a poor shot should not attempt to attack large patrols single-handed, even from a position of strategical superiority.

In attacking a patrol from the front a similar method to that described for single-seater *v.* single-seater is employed. The merits of the frontal attack upon a formation by a single machine are difficult to estimate exactly; but it may be said that the safer method is the attack from the rear.

In the surprise attack delivered on a formation from a position of strategical superiority, it is also possible to choose a straggler as the quarry. When attacking a straggler, however, it must be remembered that even if the attack is successful, the remainder of the patrol will not be demoralized or disorganized, and directly they see what is happening, they will use energetic endeavours to bring down the single machine and will be carefully watching its every movement. When a surprise can be effected it is not advisable, therefore, to choose a straggler as quarry—in fact it is a tactical error.

When attacking a formation from the same level, however, a straggler *is* a suitable machine to choose as

Digitized by Google

quarry. But first it must be reiterated that, for a single machine to attack a formation without possessing strategical superiority, is bound to be an extremely risky business. There are times, however, when such an attack is demanded. When enemy machines penetrate far over our own territory or when the success of friendly forces fighting on land or sea calls for a clear sky.

When attacking a formation from the same level, it is again of overwhelming importance that the first stroke should succeed. If the first stroke fails when attacking on the level, the single machine will be in grave danger.

Now, since the single machine has no height to gather impetus in a dive upon its quarry, it will approach comparatively slowly. This is why the straggler is the most suitable machine to attack. Most large formations have one straggler, but, if there is none, the attack must be launched upon the *rearmost* machine. If the leader were attacked, the attacker, having no margin of speed, would certainly have the rest of the patrol on his back before he could get away—perhaps even before he could engage the leader.

It is very unlikely that the attacker will be able to effect a surprise when approaching a patrol from the same level. So unlikely indeed that it would be purely a matter of luck if it ever occurred. The attacker will simply fly at any straggler of the formation, and engage him with all possible energy. The only hope for the single machine lies in the immediate success of his attack, and even then his hope is slender. If the pilot of the single machine betrays the least infirmity of purpose; the least hesitation; the least temerity, then he will assuredly be brought down. The old rules of fighting against superior numbers apply with a vengeance to air fighting when the single machine without possessing strategical superiority is matched against the patrol.

When once a single machine gets embroiled in an

Digitized by Google

enemy patrol, it must conserve height as rigidly as possible, and attack each machine it can and stick to each machine it attacks as long as possible or until it has succeeded in defeating it.

It will be seen from this discussion of the tactics employed by a single machine attacking a formation that, always, it is the first stroke that counts. Given strategical superiority, the single machine may, with moderate safety, engage a patrol of twelve by delivering a surprise attack upon the leader. It may, indeed, engage a patrol of two or more up to almost any number of single-seaters upon the same system with a great chance of success. Even if it cannot effect a surprise a sudden dash from above upon the leader has a chance of success; but *surprise should be regarded as almost essential.*

The importance of moral effect also can hardly be exaggerated in single machine *v.* patrol tactics. A patrol can be made perfectly harmless if it is panicked by a swift and unexpected first stroke. When a patrol —whether of two machines or if of two hundred— suddenly sees something flash down and up in front of its nose, and then realizes that its leader is in flames, it does not stop to examine the sky carefully to see how many opponents it has; it assumes the worst and begins circling round probably searching the sky in a very haphazard manner for machines which are not there.

Naturally machine performance has much to do with the tactics of the single machine against the patrol. The greater the advantage of performance held by the single machine, the more sure will be its success against superior odds. A single machine known by its pilot to possess a far inferior performance to that of an enemy patrol, is a dangerous vehicle in which to attack superior numbers. *At least equal performance is demanded.*

But given equal or better performance, the single machine, skilfully and scientifically handled upon the

Digitized by Google

system described, can work havoc among a large patrol. Indeed, its effectiveness raises the extremely difficult question of how far an offensive patrol may be increased in size with advantage. The strength of other kinds of patrols is determined, as shown in earlier chapters, by their duties; but how far the strength of an offensive patrol may be increased with a parallel increase to its efficiency, depends upon whether the enemy is employing large or small patrols. In other words large offensive patrols are of doubtful value unless the enemy is employing large offensive patrols, a few free single-seaters can still be given roving commissions with every prospect of their being effective.

Digitized by Google

CHAPTER X

Attack Tactics

SINGLE-SEATER FORMATION *v.* SINGLE-SEATER FORMATION

For purposes of analysis it will be assumed that each formation is composed of six aeroplanes and that it is formed up as described in Chapter II. Let it also be assumed that the friendly patrol holds the strategical superiority. First the duty of the leader will be examined, then the duty of the sub-leader; then the duty of the remaining four pilots.

The leader of the friendly patrol will pursue almost exactly the same course of action as that followed by the single machine when attacking a formation, either from front or rear, by the dive and zoom method. The patrol leader's action will differ in two points only. In the first place he must frequently count his patrol during the action, and in the second place he will not leave the enemy patrol after he has, so to speak, exhausted his stock of height. Instead he will go on diving and zooming until the aeroplanes are engaged more or less on the level.

In the dive of attack, the patrol leader will direct his fire *against the enemy patrol leader.* It is a mistake in this instance to attack stragglers, for, even if the straggler be brought down, the remainder of the enemy patrol is not disorganized and may be warned of the presence of the attackers. Our leader, then, attacks the enemy patrol leader, and of course he applies all the rules as to holding fire and effecting a surprise which he applied when attacking alone.

Digitized by Google

A further reason why the leader of the friendly patrol should single out the leader of the enemy patrol is that, by so doing, he probably engages the most experienced man, and thereby prevents that man from attacking the less experienced friendly pilots during the encounter. If the leader fails to bring down the enemy leader in the first dive, he must zoom and attack him again. And he must if possible keep the enemy leader engaged during the whole combat. If he succeeds in bringing down the enemy leader during the first dive, then he must immediately afterwards turn his attention to the next nearest enemy aeroplane in exactly the same way that he would if he were attacking single handed. He must also watch the doings of the remainder of his patrol, but especially of the machines which, in the original formation, took up positions on his immediate right and left. The reason for his pre-occupying himself with these two, and not with the sub-leader or the other two, will appear later.

Now the duties of the sub-leader may be stated. It will be recalled that the sub-leader is the last and highest man in the patrol. Like the leader he carries special markings on his machine (possibly a single streamer) so that the rest of the formation shall have no difficulty in recognizing his machine.

Immediately after observing the leader's signal that he is about to attack, the sub-leader must scan the sky above and behind the formation with extreme care. During the dive to the attack he must also scan the sky above and in the same direction as that in which he is diving and make as sure as possible that there are no hostile formations about to drop on the patrol.

As the combat is closed the sub-leader should follow the leader, but without approaching too close to him. His duty will be to protect the leader from attack from the rear while the first stroke is being delivered, and also to follow up the leader's attack upon the leader

Digitized by Google

of the enemy patrol. Thus, if our leader misses his target and zooms up, the sub-leader immediately follows with a further burst of fire on the same target. A concentration of effort against the enemy leader is effected in this manner.

Whether our leader strikes home on his first dive or not, makes no difference to the sub-leader's subsequent action. What actually takes place after the first dive has been completed is that the patrol of six splits up into two patrols of three; one led by the leader and one by the sub-leader. *The unit of three machines is the most suitable for close fighting.* It is manœuvrable and self protecting.

The sub-leader, then, after following the leader on the first attack, immediately afterwards zooms up and attacks another enemy machine. He makes no attempt to follow the leader *after* the first stoop, although he should not go too far away from him, and should attempt to keep the leader's position in mind. In formation attack no attempt is made to retain height above the enemy unless the odds are greatly in favour of the enemy. Instead the two patrols engage closely. However, it must be understood that the first dive provides the best opportunity for bringing down an enemy machine, and the subsequent battle is often fought out without many decisive victories being obtained and certainly without one side gaining any considerable advantage. Since it is the object of fighting aeroplanes to bring down enemy aircraft, the close engagement would seem unprofitable. But unless our machines possess very great superiority of performance it is impossible for them to disengage all together and gain a favourable position between each dive without allowing the enemy to escape.

Therefore, unless our machines are technically the superior, the formation battle must after the first moments be fought to a finish on the level.

The duties of leader and sub-leader have now been

Digitized by Google

outlined and we may come to the duties of the remaining four machines in the patrol of six.

The four machines dive with the leader, keeping formation on the way down. The first two, who are flying upon the leader's immediate right and left and

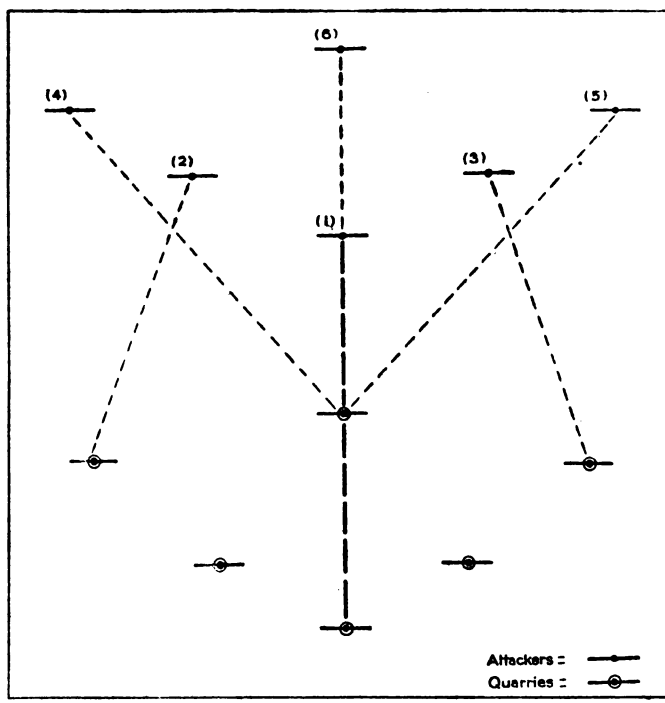


FIG. 11. Attack. Single-seater formation *v.* Single-seater formation, Selection of quarries showing concentration of fire.

who are called 2 and 3 (Fig. 2, A and C), choose the rearmost machines on the right and left of the enemy leader and aim their fire at them. The other two machines in our patrol, who are numbered 4 and 5, direct their fire during the dive of attack against the

Digitized by Google

enemy sub-leader or rearmost machine (Fig. 11). (It is being assumed that the enemy has adopted a similar formation to that of our own machines, but, if he adopted any other formation the same rules as to the attack of rearmost machines, leader and sub-leader, would apply with equal force.)

It will be observed that, during the first dive of attack, the leader of the enemy patrol is subjected to the fire of two machines; the sub-leader of the enemy patrol is subjected to the fire of two machines; two other enemy machines are subjected to the fire of two machines, and two enemy machines are not subjected to any fire at all. It will be clear therefore that the leader and sub-leader are the real objectives in the primary attack.

2, 3, 4 and 5 must be impressed with the urgent necessity of withholding their fire until the last possible moment. Frequently the patrol leader's carefully laid plans are spoilt by the novice who opens fire at an extreme range and, by so doing, warns the enemy of the presence of the attacker, destroys the surprise effect and reduces the chances of bringing down an enemy machine to a negligible quantity. *It is better for 2, 3, 4 and 5 not to fire a shot on the first dive than to fire too soon.*

Now assume that the first dive has been completed, the leader and sub-leader have zoomed up on a turn and are preparing to renew the attack. 2 and 3, after obtaining a burst of fire at close range on two enemy machines, will also zoom up and attach themselves close on either side of the leader. 4 and 5, after shooting at the enemy sub-leader, will zoom up and attach themselves to the sub-leader (No. 6 in Fig. 2, A, B and C). We now have the two sets of three machines mentioned above. After this a general melée usually occurs and the duties of 2, 3, 4 and 5 are to stick to their respective leaders and to assist each other by instantly attacking any enemy machine which is seen to obtain a favourable firing position

Digitized by Google

behind any friendly machine. *Above all*, 2, 3, *and* 4, 5 *must stick like glue to their respective leaders.*

Single-seater formation *v.* single-seater formation is fought in a very similar manner whether the opposing patrol is larger in size or if it is smaller in size than the friendly patrol. If the tactical system described be impressed upon all the pilots of a patrol, the system will work successfully no matter, within limits, what the size of the opposing force.

When once battle has been joined it is the duty of the friendly patrol to continue fighting until the enemy is driven over his own country or until heavy toll has been taken from him in the shape of crashed aeroplanes.

Unless the opposing patrol is at least double the size of our own patrol, the friendly leader, unlike the single machine, should make no attempt to avoid locking the combat. When once locked, the numerical inequality must be extreme if it is to have any very serious effect on the result of the battle.

If two patrols of 6 each meet upon the same level, leader and sub-leader will again engage the enemy leader, while 2 and 3 will engage two other enemy machines, and 4 and 5 will engage the enemy sub-leader. When meeting on the level, however, it is not always possible (especially when approaching head on) to choose the right opponent, and then the chief thing that must be aimed for is that our leader and sub-leader attack the enemy leader; and, immediately afterwards, 2 and 3 follow their own leader and stay near him at any cost, while 4 and 5 follow their own sub-leader, forming thus the two groups of three machines.

If an enemy machine spins away during this kind of engagement it is emphatically *not* the duty of sub-leader, 2, 3, 4 or 5 to follow it. If the leader of the patrol followed it (which would be a tactical error), 2 and 3 must follow the leader. But sub-leader, 4 and 5 must remain engaged with the other machines.

Digitized by Google

There is one more variation of the single-seater formation *v.* single-seater formation combat which must be examined before leaving the subject. This is when one or both of the patrols is a layer patrol. Assume first that our own patrol is in two layers of three machines each (Fig. 4, A and B). The leader of the patrol, who will be in front of the bottom layer (No. 1), observes a mass formation of six which he decides to attack. He attacks the enemy leader, and the two machines with him (2 and 3) attack the enemy sub-leader. The top layer has descended sufficiently low to watch proceedings. Immediately the battle is fully joined the top layer dives and attacks the *topmost* enemy machines. Thenceforward the two groups of three machines will be fighting in exactly the same way as described already.

Assume, however, that the leader of our layer patrol (No. 1) sees an enemy patrol of six above *him* but below the top layer (Nos. 4, 5 and 6). He immediately flies underneath the enemy patrol, hoping that the enemy patrol will dive upon him. If the enemy patrol does so, the top layer immediately descends upon the enemy patrol, and again the two groups of three machines are arrived at in combat.

But supposing our own patrol to be a six and the enemy in two layers of three each. (It must be emphasized that I select these numbers purely for convenience of illustration.) Then the first thing for our leader to do is to gain height in order to be able to attack the *top layer* as described in the part dealing with strategy.

After gaining height, the object will be to bring down some of the machines composing the top layer or to force them down among the second layer.

The dangers of collision are great during a formation engagement; but these dangers, being less than those of being shot down, cannot claim much attention from combatants. Patrol leading, so that all machines are kept together and so that the engagement is broken

Digitized by Google

off at the right moment, consists chiefly in watching what other machines are doing and attempting the almost impossible task of judging the general trend of the engagement. With a well-trained patrol, however, the leader should be able to concentrate chiefly upon bringing down enemy aircraft.

It is a surprising thing that pilots have frequently gone out on patrol with no definite idea as to their duties in a fight. They were sometimes instructed to follow the leader whatever happened, and such instruction was sound; but it was insufficient. *In order to strike with the maximum possible force each machine must possess an exact idea of the duties that are required of it during the dive and after it.*

It must be added that R.A.F. pilots are now trained to fly and to manœuvre in formation, and that this training should give them a certain facility in mass attacks. The methods by which turns are made in open formation (by crossing over, etc.) so that the machines on the inside of the turn do not overshoot and the ones on the outside do not get left behind, are interesting and worth study; but they do not fall within the province of this treatise.

Digitized by Google

CHAPTER XI

Attack Tactics

SINGLE-SEATER *v.* TWO-SEATER

It has been mentioned already that the multi-seater aeroplane is more readily surprised than the single-seater. The reason for this apparent paradox being partly psychological and partly physical: the false sense of security obtained by having a companion and the larger size of the aeroplane.

Now besides being easier to overcome strategically, the two-seater is easier to overcome tactically. *It is easier for a single-seater to bring down a two-seater than it is for it to bring down another single-seater.* This statement is certain to be regarded as false by many amateur air tacticians—which matters not; but it may also be regarded as false by a certain number of highly skilled and experienced practical flying men. Therefore the comparative vulnerability of single-seater and two-seater demands thorough examination, and the question must be dealt with at some length.

First of all let it be quite clear that no designer or magician of any age or country will ever produce a two-seater with as good a performance as a single-seater with the same powered engine. It might be imagined that the superiority of the single-seater would be sufficiently obvious to be taken for granted; but it has been stated recently that two-seaters could be built giving better performance than single-seaters, and therefore the point must be disposed of before proceeding further to enquire into the fighting qualities of the two types of machine.

Digitized by Google

Suppose a two-seater to be built which possesses a better climb and speed than a single-seater with the same engine. Then take the passenger out of the two-seater and cover in his cockpit, and it will be found that there is brought into existence a single-seater of better performance than the two-seater. This is surely a simple enough argument to penetrate to the brains of amateur tacticians. It need hardly be added that, owing to structural differences, the single-seater possesses or should possess a far bigger margin of performance over the two-seater than would be gained simply by removing the weight and wind resistance of the passenger and his gun.

The single-seater, it must be granted, therefore, owns a noticeable superiority of performance over the two-seater. It also has superiority of manœuvre. The smaller the machine the more rapid may be its manœuvre. Of course there have been large machines (the Boulton and Paul, and Avro twin radial-engined aeroplanes and the Cubarroo for example) which possess a remarkable power of manœuvre. But even these big machines cannot approach the manœuvr-ability of a good single-seater, and it may be said with finality that large machines will never be able to manœuvre with the ease and quickness of small machines any more than a crow can emulate a swallow in agility in flight.

In fighting, the single-seater possesses advantage in performance and in manœuvre.

But, it is argued, the two-seater carries an overwhelming superiority of gun-power. Whereas the single-seater may mount only two guns, the two-seater will have four. Or, if the single-seater mounts four guns, the two-seater will mount six. And, furthermore, while the guns of the single-seater are fixed and can only fire in the line of flight, one pair of guns in the two-seater are movable and can be swung so as to cover a very wide field of fire.

Superficially this advantage in gun-power and in

Digitized by Google

field of fire appears to be far greater than it actually is. If the two machines possessed equal performance and manœuvre, the field of fire and gun-power would give advantage to the two-seater. But the single-seater since it owns superior speed, climb and manœuvrability, is within limits able to place itself wherever it

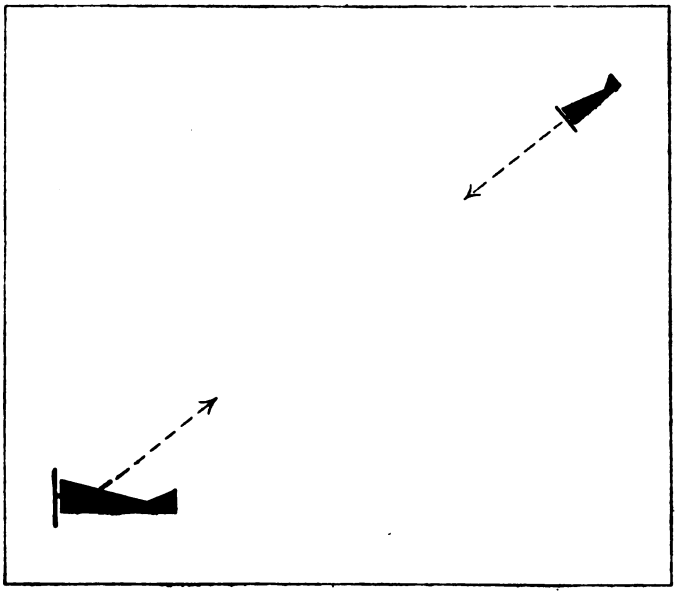


FIG. 12A. The Attack. Single-seater *v.* Two-seater. Diving on to the rear gunner.

wishes relative to the two-seater. It may not be able to *retain* a favourable position, but it will be able, if it so desire, to avoid, in part at least, the fire of its opponent's front fixed guns and back movable guns.

Moreover, the more sluggish manœuvres of the two-seater cause it to present to the single-seater a comparatively easy target; whereas the swift movements of the single-seater prevent a steady sight being taken upon it in return.

Digitized by Google

But assume that the single-seater is, for some reason, unable to avoid the fire of the two-seater's back guns; or that the single-seater pilot decides to take a chance (Fig. 12, A). Then the two guns of the single-seater (it is being assumed here that there are two, for increases in armament will not affect the truth of the argument) are firing forward at the gunner of the two-seater. The single-seater pilot must allow, or aim off, only for the direction of his opponent's machine and not for his own direction. The single-seater pilot, while he is shooting, is protected by a shield which covers all his body except for the top part of his head. This shield is the engine (Fig. 12, B).

He directs his fire against an entirely unprotected pilot and an observer who is turning and aiming his gun in a gale of wind of at least 50 m.p.h. even if the two-seater pilot has slowed up to give his observer the benefit of the least possible wind pressure against his gun (Fig. 12, C). The observer must allow, or aim off, for the movements of the single-seater *as well as for his own movement.* If this aiming off is partly accomplished by an automatic wind-vane sight it is all the more liable to be inaccurate.

Assuming, therefore, that a single-seater dives straight on to the back guns of a two-seater, and assuming equal shooting ability on the part of both two-seater observer and single-seater pilot, then the single-seater possesses an overwhelming advantage in fire. It would be impossible to calculate the actual chances, but it may safely be said that the fire of the single-seater pilot is at least three times more likely to take effect than the fire of the observer.

Bishop, with his characteristic insight into the strength and weakness of fighting aeroplanes, said: "Many people think of the two-seater as a superior fighting machine because of its greater gun-power. But to me they (two-seaters) always seemed fair prey and an easy target."

Guynemer on occasions attacked two-seaters without

Digitized by Google

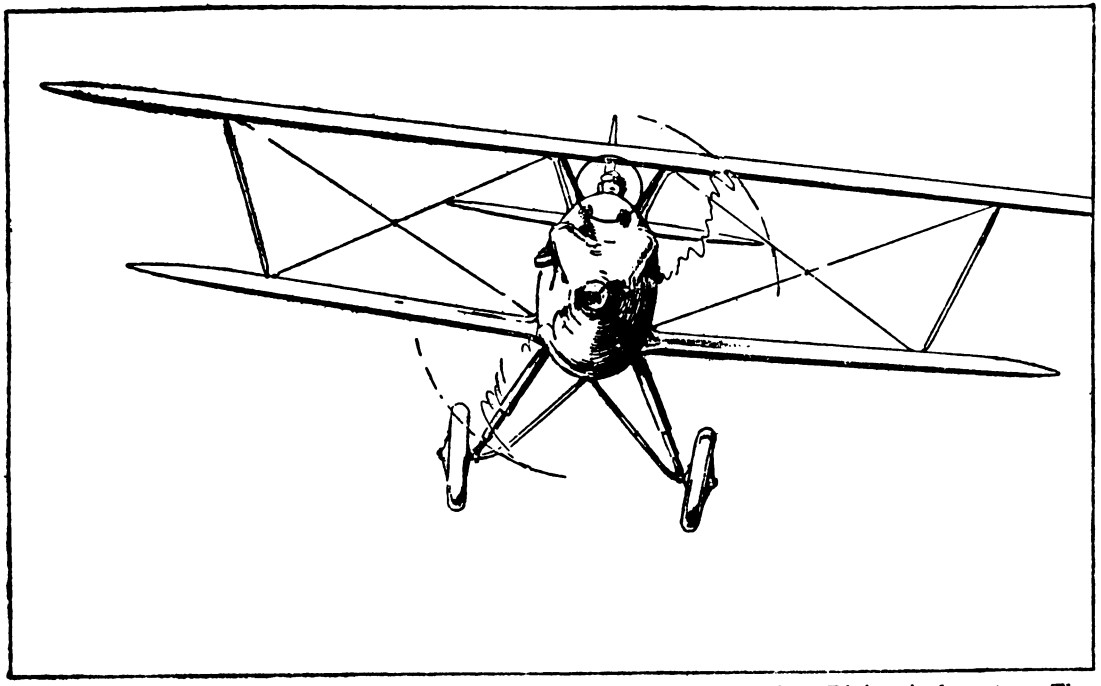


FIG. 12B. Target—enclosed by circle—presented to a Two-seater gunner by a Diving single-seater. The vital parts in the Single-seater, pilot and main fuel tanks, are armoured by the engine and machine guns. Moreover the Single-seater pilot is "aiming oft" only for direction of his enemy.

Digitized by Google

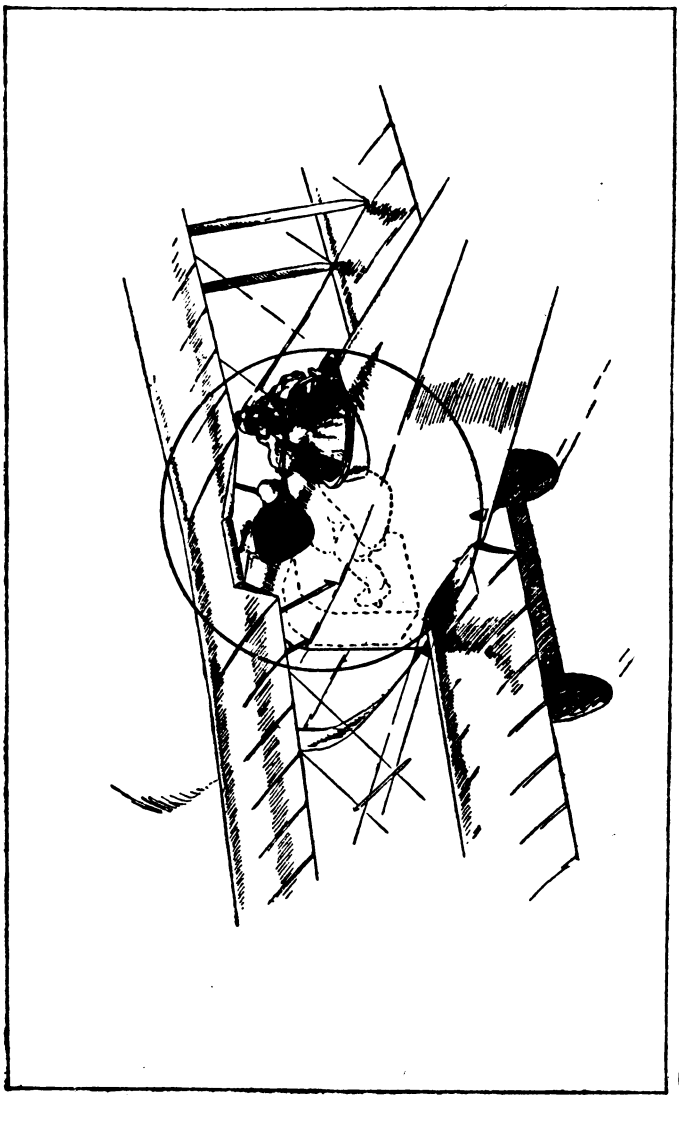


FIG. 12c. Target—enclosed by circle—presented to a Single-seater pilot when he is diving on a Two-seater. Observer, pilot and all fuel tanks are unarmoured. Moreover, Two-seater gunner must "sign off" before

Digitized by Google

attempting to approach them from a blind spot. He would take every precaution to effect a surprise, of course, but after that he did not consider the chances of his being hit by the rear gunner before his own fire had taken effect, to be so serious as to demand any very special precautions.

Now, having dealt fully with the relative fighting strengths of the two types of machine, we may proceed to the tactics which will be employed by the single-seater when it is attacking a two-seater. Naturally all the different modes of attack are interconnected, but for purposes of analysis they may be divided into five: (1) the vertical dive, (2) the approach from underneath a wing tip, (3) the attack from underneath the tail, (4) the change-over dive, (5) the dive on to the rear gunner.

All methods of attack must partake of the main features of the dive and zoom method and not of the in-fighting method. The single-seater should prevent itself from being closely engaged by a two-seater for any length of time by using its powers of speed, climb and manœuvre. Intentionally the *single-seater will never remain closely engaged with a two-seater except so long as it can hold a position of tactical superiority.* Thus so long as it can remain under the tail of the two-seater the single-seater might stay close to its quarry. But should the two-seater execute a manœuvre which precluded the single-seater from remaining under the tail, the single-seater must instantly disengage and return to the attack from a position of advantage.

"Il faut savoir se dégager pour mieux attaquer ensuite," says Fonck.

First take the vertical dive method. In this the single-seater plunges almost vertically down upon the enemy and, during the final period, delivers a burst of fire. The vertical dive is extremely difficult to judge and it can be performed only when both machines face in the same direction. The vertical part of the

Digitized by Google

dive will occur as the single-seater is coming within range and then, in keeping its sights on the enemy, it will be gradually flattening out until the moment arrives when it must zoom up again.

In this method it is practically impossible for the enemy observer to obtain an accurate shot while the dive is vertical. But, as the dive remains vertical for an extremely short time, the method has little to recommend it. It is difficult to aim and shoot when diving, and it is difficult to pull out soon enough yet not too soon. Naturally, in zooming up, a rapid turn will be made; for it is then that the opposing gunner may get in a successful burst of fire. The vertical dive method is very bad. It has been mentioned solely because it has been used by a few pilots with moderate success and it has been advocated by many pilots.

Secondly there is the method by which the single-seater approaches the two-seater from a point below and in front of it. The bottom plane of the two-seater hides a large part of the field of vision downwards and forwards in many types of machines. If the direction is not downwards and forwards it will be downwards and sideways or downwards and backwards; but always, with a normal biplane, there will be a blind spot somewhere under the wings. This method of attack then consists in diving from the strategical position past the two-seater and at one side of it, out of range and with both machines facing in the same direction. Having passed the two-seater and having dived several hundred feet below it, the single-seater pilot will make a turn—it must be a gentle turn owing to the accumulated speed—and approach towards one wing tip of his quarry (Fig. 13, A, B and C).

From this position not only will the crew of the two-seater be unable to return fire but they will be unable to see their attacker. The single-seater will approach to point blank range beneath the two-seater and will then turn and retire beneath its opponent's

Digitized by Google

opposite wing (Fig. 13, B and C). Thus, during the whole period that the single-seater is within range of the two-seater's guns, those guns will be unable to fire at it.

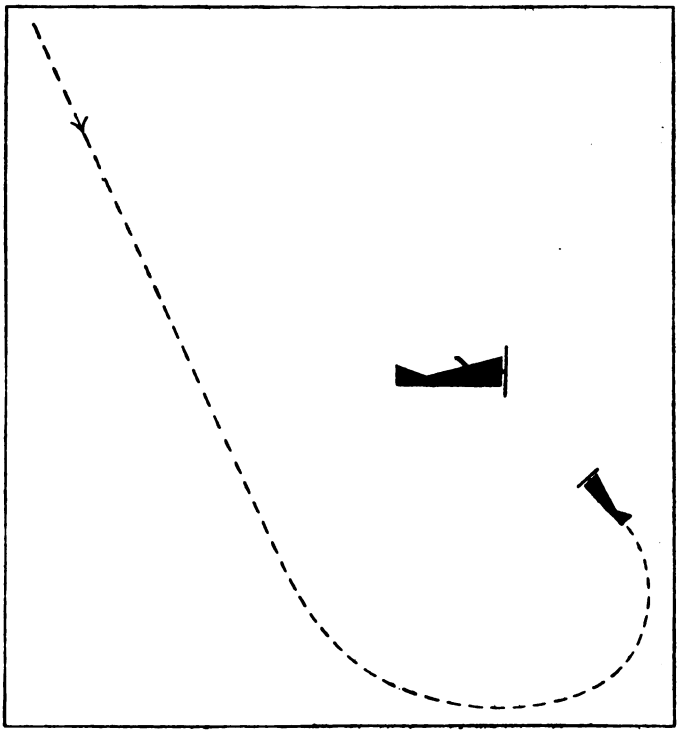


FIG. 13A. Attack. Single-seater *v.* Two-seater. Approach from underneath a wing-tip. Side elevation.

Modifications of the above described manœuvre are demanded of course when the two-seater makes a turn. But, even so, it will usually be found possible exactly to follow out the manœuvre *relative to the two-seater*. If the two-seater is undamaged by the

Digitized by Google

first attack the single-seater will gain height and then attack again in the same manner.

Coupled with surprise this is a deadly method of attack. In order to judge the dive and the shooting,

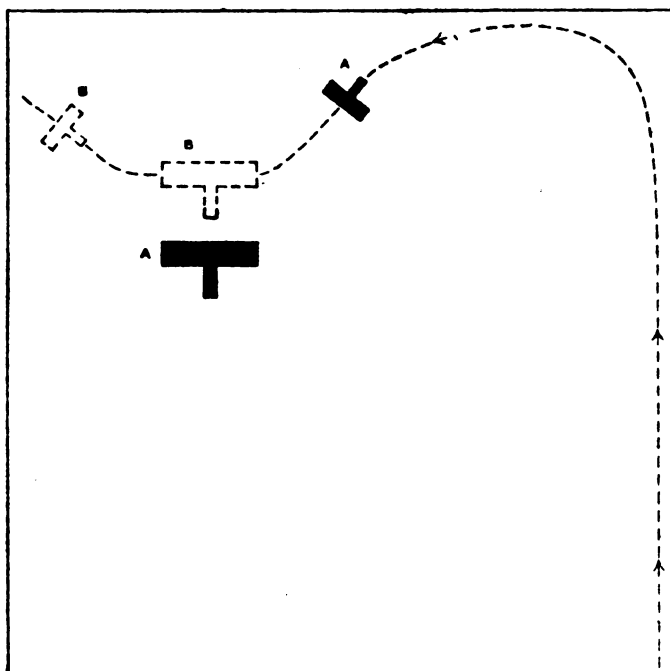


FIG. 13B. Attack. Single-seater *v.* Two seater. Approach from underneath a wing-tip. Plan view. A A: approach. B B: retirement.

however, a good deal of practice is necessary. The great advantage of this method is that the *retreat* as well as the advance of the single-seater is covered.

The third method is the attack from under the tail (Fig. 14). This is the simplest method and was the most popular. The single-seater dives down well to

Digitized by Google

the rear of the enemy two-seater and, on a subsequent *gentle* zoom, arrives without any excess speed at a position below and behind the enemy's tail. He then has an easy no-allowance shot and the enemy observer

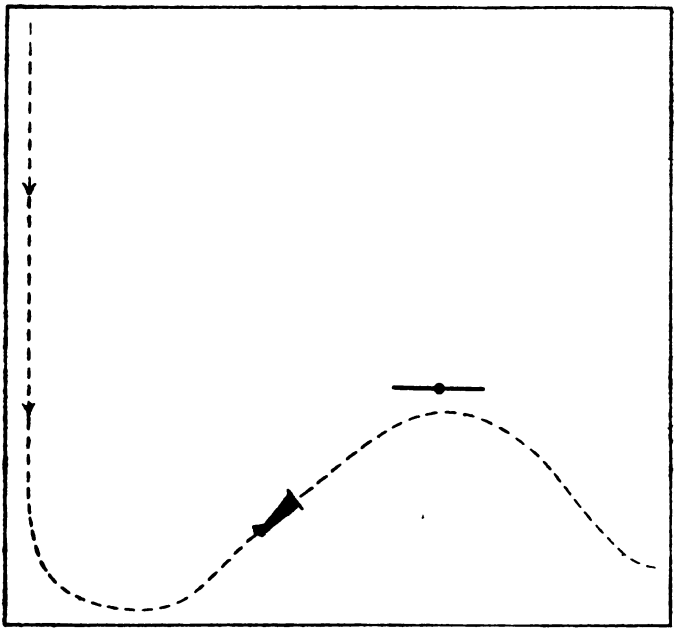


FIG. 13c. Attack. Single-seater *v.* Two-seater. Approach and retirement from underneath a wing-tip. Front elevation.

cannot return fire without shooting away the tail plane of his own machine.

A disadvantage of this method is illustrated when a good two-seater machine, well handled, turns sharply enough to prevent the single-seater from keeping under cover. The observer may then get in a burst of fire at close range before the single-seater can regain a favourable position. For it must be remembered

Digitized by Google

that the single-seater can have no excess of speed if it is to remain in position. A variation of this method is therefore probably safer.

This variation is accomplished in this way: the single-seater dives as before but passes closer behind the two-seater and comes up under the tail of the two-seater with a *big margin of excess speed.* It gets in a short burst of fire and immediately dives again at a gentle angle but at a high speed with engine on, turning and escaping under a wing-tip of the enemy machine (Fig. 15). If the first attempt fails

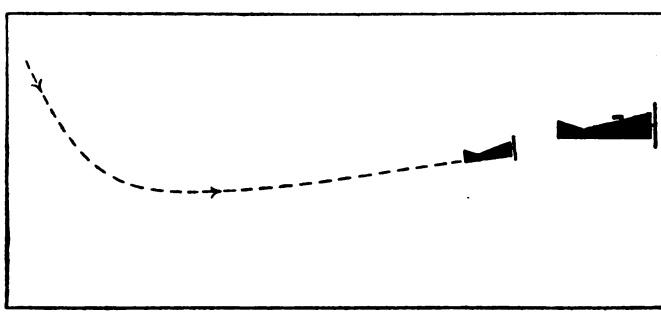


FIG. 14. Attack. Single-seater *v.* Two-seater. Slow approach under the tail.

a second may be made when using this system. It is unlikely, however, that the single-seater will arrive at close range without turning on the dive during the second attempt when the two-seater knows of its presence. This method may therefore be advised as extremely effective when a surprise has been assured, but not otherwise.

A second variation of the under-tail attack is effected by the single-seater approaching as before with a big margin of excess speed, and then escaping by half-looping round the front of the two-seater and then half-rolling level at the top of the loop. Thus, after the complete manœuvre, the single-seater is going in the opposite direction to the two-seater.

Digitized by Google

The fourth method in single-seater *v.* two-seater is the change-over dive. The dive is made at not too high a speed approaching, say, the starboard side of the two-seater. The observer trains his gun if he sees the single-seater coming. As he comes within range

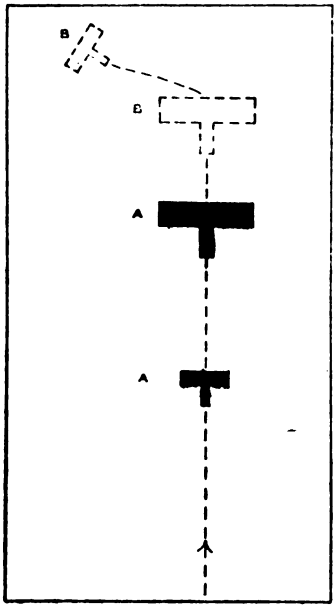


FIG. 15. Attack. Single-seater *v.* Two-seater. Approach from under the tail. A A: approach. B B: retirement.

the single-seater pilot suddenly flattens out, turns and dives on the port side of the machine. Frequently, surprising as it may seem, in actual warfare the observer on these occasions failed to shift his gun round in time to open fire. And in order to obtain a shot during the single-seater's retreat he must shift his gun again. This method of attack is not to be recommended, although frequently it has been applied successfully. It is clumsy, and there is always a possibility—which

Digitized by Google

will be more like a certainty in future wars—that the observer may be able to swing his guns in time.

A variation of the change-over dive is the change-over zoom, in which the two-seater will be approached from below.

The fifth method is the direct method (Fig. 12, A). In this the inherent advantages of the single-seater for shooting and protection against the observer in the two-seater are relied upon, and (always with surprise if possible) the single-seater dives straight from behind its opponent on to the rear gunner.

The retreat is executed by a straight zoom continuing in the same direction and with the pilot watching to see that the gunner has not swung his gun in time, and that the two-seater pilot cannot pull up the nose of his machine enough to deliver a burst of fire.

Mention must also be made of the head-on method. In this all the advantages possessed by the single-seater over the two-seater for fighting purposes are ignored, and the two-seater is met on level terms. To attack in this manner when the fight is between two machines with no extraneous circumstances forcing the pilot to adopt one method more than another, is a tactical error. It has been done successfully, but that is no excuse for it. The late Flight-Lieut. Oliver Sutton (who invented the Sutton safety belt) once attacked an enemy machine in this manner while he was in a patrol which I was leading, and I was thus able to observe and to judge the value of the head-on method in actual use. I saw the machines approach each other to within a very short distance, and, when Flight-Lieut. Sutton zoomed up, pieces of wings scattered in the air and the enemy machine broke up. Upon landing it was found that Flight-Lieut. Sutton's machine had about a foot cut off the top starboard wing-tip. This serves as a warning against the head-on method of attack when another can be employed.

Digitized by Google

The single-seater pilot, when attacking a two-seater, may sometimes obtain advance information of the enemy's manœuvres by watching the rudder of his machine. The rudder moves over slightly before the machine begins to turn.

Finally it may be reiterated that all attacking by a single-seater against a two-seater should be initiated from above, and that in-fighting should be avoided. It may also be said that the three tactical methods to be recommended are the approach from a wing tip, the approach under the tail with a margin of speed, and the direct dive on to the gunner.

While attacking a two-seater the single-seater pilot is secure in the knowledge that the chances of his being hit are remote compared with the chances of his obtaining a hit. But it is in the retreat that he must be specially careful. The whole thing may be summed up thus: the approach should be made from any direction where a good shot may be taken; *the retreat should be made in a direction in which the enemy cannot open fire.* During the retreat the machine may be side-slipped or otherwise kept on an irregular course so as to present a difficult target for the enemy.

Digitized by Google

CHAPTER XII

Attack Tactics

SINGLE-SEATER VERSUS FORMATION OF TWO-SEATERS

When one single-seater attacks a formation of two-seaters, success is more dependent upon strategy than upon tactics. Obviously one single-seater which became thoroughly embroiled with six two-seaters would very likely be shot down. It must rely upon striking quickly and then escaping.

The general outline of the method of attack to be adopted by a single-seater against a formation of two-seaters is very similar to that adopted against a formation of single-seaters. But it is important always to remember that, while a machine flying as little as 300 yards immediately above a number of single-seaters is safe, a machine flying the same distance above a two-seater patrol is in danger. In other words the process of retreating after the attack from a two-seater patrol must be carried out with circumspection if a position beyond range of the observer's guns is to be reached in safety.

The success even of the retreat, however, depends in a large measure upon the strategy which has been employed. Always when engaging greatly superior numbers strategy assumes paramount importance, and tactics plays a minor rôle. Of course men have flung their machines into the middle of hostile patrols and fought with a measure of success. But although they sometimes have caused great execution on these occasions, in the majority of instances, they have been themselves shot down immediately. It is hard to

Digitized by Google

hear authentically of any fighting pilot with a large number of victories to his credit who ever attacked superior numbers by flying straight at them and allowing his machine to become embroiled in in-fighting.

Since the object of strategy and tactics is to learn how to defeat the enemy, the method of boldly engaging formations without thought of how the retreat may be effected need not be touched upon in this book. Such a hazardous method of attack is simply a spectacular system of courting defeat.

There are methods, however, by which large formations may be attacked by one single-seater with reasonable prospect of success. And, as was implied when a description of "single-seater *v.* formation of single-seaters" tactics was given, victory against superior numbers is very largely influenced by the aeroplane designer. "La guerre aerienne," says Fonck, "est essentiellement une guerre de vitesse. Nous pourrons donc dire que, dans le combat aerien, la primauté tactique depend de la supériorité technique de l'avion." The technical side of aviation is inextricably bound up with the strategy and tactics of air warfare. It is impossible to speak of air warfare without also speaking of aircraft design.

It was shown, in the last chapter, that the single-seater will always possess a better performance than a two-seater, and this premise must again be mentioned here. If the single-seater does not possess a better performance than the two-seater, it had best go home. Another result of the mingling of technicalities with strategy and tactics is that when analysing air fighting it must be assumed that friend and foe's machines of like types perform alike. Upon no other assumption is a clear view upon air fighting obtainable. It is also necessary to assume the ladder of performance which has been suggested already. The bomber is a low performance machine, the two-seater fighter a high performance machine, and the single-seater the

Digitized by Google

highest performance machine. When designers or choosers of war aircraft make mistakes, and a two-seater appears with a better performance than a single-seater, a modification in strategy and tactics becomes necessary. But consideration of all the problems involved when such mistakes occur would take too much space to be usefully included here. Moreover, if the strategical and tactical systems described are thoroughly mastered, a broad grasp of the principles of strategy and tactics in the air sufficiently comprehensive to allow minor alterations to be devised if the necessity arises should be obtained by the reader.

It is therefore assumed for this chapter that the single-seater possesses a clear margin of performance over the two-seaters it is to attack. Throughout the attack the single-seater pilot will take full advantage of that superiority of performance. First he will use all possible cunning to achieve a surprise—that part is strategical—then he will study to retrieve as much height above the hostile formation as possible after the dive of attack.

It will be seen that the single-seater pilot will place great reliance on the technical superiority of his machine. The essence of tactics against a formation of two-seaters is the right use of performance.

A detailed description of the method of fighting one single-seater *v.* six two-seater fighters will now be given. Two-seater fighters will possess a better performance than bombers, and they will be able better to defend themselves than reconnaissance machines; so that this example will show by implication the method which may be employed against any formation of two-seaters or multi-seaters.

Naturally, as it has been made clear already, an attack against great odds is risky. Much will depend upon the attacker's skill and confidence. First let it be assumed that he has succeeded in surprising the six two-seaters. The single-seater must dive straight on to the rear of the *leader* of the two-seater formation

Digitized by Google

(see Fig. 2). If the surprise has been carried out properly, no back gunner will open fire before the single-seater has opened fire. It is vital that the first burst from the single-seater tells. If the patrol leader is shot down on the attacker's first dive, the patrol will be disorganized and this will make the escape and subsequent attacks easier. The attacker will rely upon the protection afforded by his engine in the event of the two-seater gunners observing him in time to open fire.

Now it is clear that, in order to reach the leader of the patrol, the single-seater must pass over the tops of the five other machines. If the surprise is complete, and if fire is withheld until the range is close, those five gunners should not be able to bring down the single-seater, for they would not have time to shoot under suitable conditions. The longer time they are given to shoot, the greater will be their chance of success, so the single-seater must deliver his attack at the highest possible speed consistent with well-aimed shooting.

The single-seater must dive with engine on, and, by the time he comes within range from the hostile guns, he should be travelling at exceedingly high speed. Owing to this high speed, he will escape more easily and spend less time within range.

Directly he presses the triggers of his guns, the attacking pilot will advertise his presence to the hostile formation and, within five seconds, several guns will be trained upon him. Those five seconds should be sufficient (in them the single-seater will travel more than 300 yards) for delivering his burst of fire. Afterwards the single-seater must escape. He may escape by zooming, at the same time turning to a flank and, by means of the rudder, inducing sufficient sideslip to present a difficult target for the hostile gunners. Or he may zoom straight upwards at the same time side-slipping slightly, bearing in mind the great strain imposed upon the machine by

Digitized by Google

side-slipping at so extreme a speed. The first method of retreat (while turning to a flank) is usually the better one because it puts a greater distance between the opposing aircraft in a given length of time than the straight zoom system.

If the patrol leader has not been shot down on the first attack, great care must be taken before attacking a second time. In fact, it would not usually be advisable to attack a second time without further strategical operations. If the patrol leader has been shot down, however, an immediate second attack should be made upon the rearmost, or upon an isolated machine. Height must be conserved with extreme care, so as to avoid being embroiled with the formation.

Some French pilots retreated from two-seater formations after delivering the attack by continuing the dive and trusting to their accumulated speed to take them out of range quickly enough to ensure safety. This system possesses the advantage that some of the two-seaters will not be able to fire at all at the retreating single-seater for fear of hitting their friends in front; and both the fire and view of others may be masked by their lower planes. But the system is not to be recommended. For one thing, if the retreat is effected by diving, a second attack under the very favourable conditions produced if the first one proves successful is impossible. For another thing, the accumulated speed of the first dive is soon dissipated. Certainly, if the single-seater keeps going, the two-seaters will be unable to get within range again, but, if for any reasons the single-seater is delayed (by engine trouble for example), they may reach it and counter attack with the single-seater at a very serious disadvantage. Generally speaking, height should be sedulously hoarded therefore.

Owing to the value of height, attack cannot be made safely, even when using the dive and zoom method, by a single-seater upon a two-seater formation *from below*. The lowest point in the dive determines how

Digitized by Google

much height can be retrieved on the subsequent zoom, and, if that lowest point is below the enemy formation, the single-seater may barely be able to get out of range again on the zoom.

Assume now that circumstances arise owing to which it becomes necessary for one single-seater to attack a formation of enemy two-seaters without being able to effect surprise. It might happen that an enemy formation were found flying over a friendly town or far over friendly territory, and then it would probably be necessary to attack without the expenditure of time which is demanded in order to surprise the enemy.

Between the tactics to be adopted when surprising and not surprising an enemy formation there is only one great difference. A different machine must be chosen as quarry. Without surprise a straggler, or the hindmost machine of the formation should be chosen for attack and *not the leader*. A moment's reflection will make the reason for this distinction clear.

When the hostile formation is ready for the attack, all the gunners will be waiting and will open fire as soon as the single-seater comes within range. If the leader were chosen for the attack, the single-seater would spend longer within range than if it directed its fire against a straggler. It would need to pass right over the other machines. The subsequent retreat must be made on the sharpest turn consistent with not overloading the wings of the machine. If the retreat is effected by a straight zoom the single-seater will, for eight or ten seconds, be a mark for all the gunners in the formation. Whereas, if a straggler is chosen and a turn made on the zoom, the single-seater may be within effective range of the hostile gunners for only six seconds; or little longer than in a surprise attack.

Attack upon a formation of reconnaissance or bombing aircraft is made in exactly the same way as

Digitized by Google

upon fighting two-seaters; but the hostile formation is, of course, rather less formidable. Bombers do not possess as good a performance as two-seater fighters, and both bombers and reconnaissance aircraft usually need to fly on a definite course. They are therefore not so free to reply to attacks make upon them.

But bombers may have extra gunners on board firing through gun tunnels under the tail, or from nacelles in front of and, perhaps, in the extreme tail of the machine and, in consequence, there is an alternative method of atacking them which requires mention.

By this method the rearmost machine is chosen as quarry, and the single-seater approaches on the same level as the bombers and travelling only a shade faster. The single-seater will not be embroiled with the bombers because they are flying on a definite course and cannot afford to lose time in manœuvring. For example, the Gothas which bombed London during the war very rightly refused to be drawn into engagements with British machines, but kept to their course. The single-seater pilot may, with reasonable security, and under like circumstances, rely upon the bombers not turning in formation, and may attack on the same level. Even if the bombers do turn, the single-seater's extra performance should allow it to climb above quickly without the aid of excess speed accumulated in a dive.

The single-seater, as it has been said, will approach the rearmost bomber on a level with it. It will close up to within range and, keeping directly behind the bomber's tail, will open fire. The advantage of this system is that the engine acts as a protection for the single-seater pilot. It is a suitable means of attacking, single-handed, formations of bombing aircraft which have penetrated over friendly territory. It has the disadvantage that it is very unlikely to break up the formation and that, if there are tail nacelles, a bigger gun-power may be trained upon the single-seater than he is able to train in reply and also that it is difficult

Digitized by Google

to effect a surprise because the hostile formation must, of necessity, be approached slowly or the single-seater will overshoot.

If, for any reason, a single-seater pilot does not wish to launch a close-range attack on a formation of bombers, he may begin tactical operations by long range sniping in the hope of isolating a machine. Obviously this method would not be used if there were any chance of effecting a surprise.

It was said in the Preface that where theories have been advanced in the Royal Air Force which present any intrinsic interest, they would be mentioned. At the same time, for reasons which were shown, these theories have, as yet, never been convincingly demonstrated even on manœuvres, and it is impossible to predict how they would work out in warfare. Some would almost certainly prove ineffective, but among those which show faint practical possibilities are the methods advanced for a number of single-seaters in attacking one multi-seater.

The methods permit of the attack being launched from two or three directions at once, so that the multi-seater gunners may not be able to meet every attacker with answering fire. One arrangement consists in detailing the members of the patrol for separate sides of the quarry. Thus, three single-seaters would approach one from the quarry's starboard side, one from the port side and one from the rear. The attackers swing out to their respective posts as the quarry is approached, and an exact plan is necessary to avoid risk of collision subsequent to the attack.

The other arrangement consists in a simultaneous attack from above and below and is worked upon a similar system, except that the third machine remains above acting as an escort to the attackers.

If these methods prove practical, they should be useful in making doubly sure of the quarry. But they seem to ignore the true balance of power between single-seater and multi-seater. Moreover, if

Digitized by Google

three single-seaters find one multi-seater alone in an empty sky where there is no probability of other attack, there should never be very great difficulty in bringing down the multi-seater. Innumerable variations of the attack from two or more directions can easily be thought out, but always care must be exercised in planning the retreat of the attackers.

Finally, it is clear that speed and climb are the twin guardians of the single-seater when attacking superior numbers; but especially when attacking formations of two-seaters or multi-seaters. The attack must be sudden and of short duration and the single-seater pilot must remember that the tail of his machine and its flanks are very vulnerable; while its nose is, in effect, heavily armoured by the engine. Whenever necessity demands that the tail of the single-seater be presented to the enemy guns, the single-seater should be manœuvred or side-slipped so as to present as difficult a target as possible.

If a single-seater possesses a good performance it can tackle, with reasonable safety, large formations of multi-seaters. Good shooting, extreme swiftness of approach and departure are the things that have the most important bearing upon success.

Fonck describes an attack he made single-handed upon a layer patrol of eight machines. There was one large machine leading the whole formation and escorted by two others. Above these, there were five other machines. Fonck climbed to a great height and flew far over enemy country until the enemy machines appeared to him like little black dots (see Attack Strategy). He then *chose the large machine which was leading as his quarry* and dived "à toute vitesse." He passed between the two machines which flanked the leader, reached point-blank range and opened fire. At the first burst the large enemy machine burst into flames. Fonck's accumulated speed (gained as a result of the dive) took him out of range of the two flanking machines before they could gain firing

Digitized by Google

positions. The five machines above, upon seeing their leader in flames, picked up Fonck's Spad and dived upon it. "I had five seconds start of them," says Fonck, "it was enough . . . let them run. . . ."

Digitized by Google

CHAPTER XIII

Attack Tactics

LAYER FORMATIONS, AIRSHIPS, CAPTIVE BALLOONS AND NIGHT-WORK

In the description of Fonck's attack upon the formation of eight machines given in the last chapter, it may have been noted that the enemy were in layer formation. Fonck saw the five machines flying above, but adopted the apparently mistaken tactics of attacking the leader of the three machines *below*. Bishop also describes an occasion when he saw a layer formation with two machines below and three above, and how he attacked the lower two, drove one off and shot down the other before the top three machines were able to reach him.

If the first principles of strategy and attack tactics in the air have been grasped it will be clear that in a layer formation, theoretically at any rate, the top formation should be the first focus of attack and not the bottom one. The bottom formation cannot come to assist the top one and one single-seater or a formation can safely attack the top layer without fear of being taken at a disadvantage from above. Yet here are Fonck and Bishop, who understand more about air fighting than anyone, attacking the lower formations in the full knowledge of what they were doing.

The explanation of this apparent contradiction lies in the arrangement of the layer formation itself. If a layer formation is spread out too much, it is possible to launch a swift attack on the lower layer and retire

Digitized by Google

or be in readiness for the top layer, by the time the top layer has dived down to the rescue. But, if a layer formation is correctly arranged with not too great a distance between one group and another, it would be a grave error to attack the lower layer without having first scattered or disabled the higher layer

The nature of the attack upon a layer formation, therefore, must be ruled to a certain extent by the distances between layers. Always, however, it is *safer* to attack the topmost machines. One single-seater may make a running attack upon the lower machines successfully and can do so if the distance between groups is large; but a patrol would not be likely to be able to extricate itself from the combat with the same swiftness as a single machine and, for this reason, a patrol should confine itself, in all but exceptional circumstances, to attacking the topmost layer first.

Apart from this the single machine or patrol which attacks a layer formation will in effect be pitted against a normal patrol, and therefore the methods employed should correspond exactly with those already described.

A remark about the layer formation as an instrument of attack must be added before concluding this examination of attack tactics on heavier-than-air craft. For offensive purposes, the layer formation is not so suitable as it is for defensive purposes. It is inclined to be unwieldy and the higher group of machines is apt to lose touch with the lower machines at critical moments. For defensive purposes it is, if rightly constituted with the layers close together, a very powerful instrument.

ATTACK UPON AIRSHIPS

Much interest in airships has been aroused recently by the beginning of the construction of the 5,000,000 cu. ft. airship by the Airship Guarantee Company and of the R.101. Enthusiasm has gone so far that the former opinion that airships were virtually useless in warfare has, by many people, been reversed. Officially,

Digitized by Google

there is a strong bias in favour of airships as instruments of war. It is hinted that they will be of great value to the navy.

Close consideration of the problems of air warfare provides convincing evidence that, during hostilities, airships will be, not only incapable of rising into the air near any area of operations, but unable to exist either in sheds or at mooring masts within three hours' cruise from any scene of operations. And if they are not able to fly over or to exist near any scene of operations, they could scarcely be of use as vessels of war.

It must be remembered that heavier-than-air craft can now operate at great distances from their base. If airships were precluded from operating in places where heavier-than-air craft could penetrate, they would find their field of action circumscribed. Furthermore, if they are never to meet hostile aircraft, or to operate where hostile troops, ships or submarines are operating, they are not vessels of war.

However, it is advisable to point out two things about airships in warfare that seem to be ignored, or at least not fully to be appreciated, by many people. One is that an airship can be destroyed by other means than by setting fire to the lifting gas, the other is that an attack on an airship by a single-seater could be a surprise attack.

It has been said that, if helium were used instead of hydrogen for lifting purposes, a fully armed airship would be able to resist attack by a patrol of single-seaters. Never was there so mistaken an idea. One single-seater would usually be sufficient to bring down an airship, whether helium-filled or gas-filled. It must be recalled that guns firing 37 mm. shells were used on aeroplanes in the last war and that, since the war, explosive ammunition more effective than any previously invented, has been produced. Aeroplanes have been shot down times without number by attack upon the spars, struts and wires, and the girders of an

Digitized by Google

airship offer a huge target. An airship could be broken up very easily by a suitably armed single-seater.

But, besides breakage, the fuel tanks could be set on fire. They would be protected, of course, but not heavily, or the airship's performance would suffer and, for war purposes, good performance is essential. The tanks might contain heavy oil. But, according to a technical report issued by a Government experimental department, heavy oil is, in many circumstances, *more readily set on fire than petrol.*

Then again there are the protecting aeroplanes which would be carried in slings and be able to take off from and attach themselves to the airship in flight.

Those who claim that the carrying of these aeroplanes is a protective device for airships accuse themselves of ignorance of air fighting. The impression that an aeroplane could be launched and then hold off an attack, even by one single-seater, could be held by no person with experience of war in the air. It is remarkable that it has been possible to foist such an impression upon so large a number of people.

I have repeatedly pointed out that surprise is the most potent factor in air warfare. A cruising airship would be more readily surprised by an experienced pilot than any other aircraft. Of what use are these aeroplanes slung to the airship when the airship is surprised? If the process of starting the engines and releasing the aeroplanes took one-twentieth part of a second, they would be too late! The attack on the airship would have been launched, and gunners on an airship have no better chance than the gunners in a formation of aeroplanes. It is said that the gunners would have bigger guns and so would be able to shoot down aeroplanes more easily. But bigger guns *reduce* their chances of shooting down aeroplanes. You cannot kill flies with a rifle. The airman fears a machine-gun more than a 15 in. gun, because, in the air, it is *rate* of fire which counts first.

A hydrogen-filled airship, whether it be gas-armoured

Digitized by Google

according to Commander Boothby's scheme or not, would be dead meat to a single-seater. Helium-filled, an airship would not be much safer. If a strong escort of heavier-than-air craft were continually flying round and above it wherever it went, an airship might precariously approach the scenes of operations. But with so many heavier-than-air craft in the air why have the airship?

Lest these views be suspected of being prejudiced I must say that I believe that airships may have a great value for some kinds of commercial air transport. I believe that research into airship problems should be pursued with vigour. But at the present day it would be as sensible to approach an entrenched enemy in a cardboard tank as to go to war in an airship.

It is advisable that enthusiasm naturally engendered by the bold policy adopted for building commercial airships be not allowed to run off the track and dash itself to pieces upon a theory of their war-time value untenable in the light of practical experience.

It must be added that, at night, airships and aeroplanes by means of the two new systems for picking up machines in the dark will be far more readily discovered by airmen in defending aeroplanes than they were in the last war.

ATTACK UPON CAPTIVE BALLOONS

There is very little to be said about attack tactics upon captive balloons. The strategical side (Chapter VI) has the greater effect in determining the success or failure of attack upon a balloon. Incendiary ammunition must, of course, be used. The shots must be fired in a moderately steep dive at a range of under 200 yards. Certain kinds of incendiary ammunition become unstable (and inaccurate) over 200 and 300 yards range, but it is to be presumed that in future wars the R.A.F. would be issued with the more modern and more accurate kind.

During the war several French pilots specialized in

Digitized by Google

attacks upon captive balloons, and the system of specialization is a good one. A pilot who has spent all his time on patrol looking for, and attacking, aeroplanes, will not readily judge his range when attacking a balloon, owing to the extreme difference between the sizes of the two kinds of aircraft. He will be inclined to fire when too far away.

The attack tactics which have been successfully employed against every kind of aircraft which has attained a degree of practical utility, have now been described. It is unlikely that, for many years, pilots will require to know how to surprise a helicopter, or how to approach an ornithopter, an autogiro, or a rotor aeroplane. And if these, or any other novel types of aircraft leave the experimental stage, it would be necessary to carry out carefully arranged *realistic* manœuvres before it would be possible to say, with any degree of finality, what would be the best means of attacking them in war. All the methods which have been described, it must be reiterated, are the results of the actual experience of fighting pilots in warfare.

NIGHT-ATTACK TACTICS

All the methods of attack by day can be employed by night; but, as a general rule, it is advisable to adopt only the simpler ones. Moreover, since there is always a possibility of losing sight of the quarry if it makes a sudden manœuvre, it is advisable to launch an attack at night at a lower speed than by day.

The only tactical method which has been originated for night work is "upward shooting." In this method the fighting machines carry extra, fixed guns which point upwards and forwards. The angle of these guns is such that, if the attacker flies below his quarry and maintains a no-allowance sight upon it, the effects of speed and direction of the two machines upon the bullets cancel each other. Considerable accuracy at extreme ranges has been obtained during trials of this

Digitized by Google

system of upward shooting; but the new methods of detection at night may reduce its value in the future.

Of night tactics it may be said that they differ from day tactics only inasmuch as they are less elaborate. In the attack a broad general outline is imperative, and finely detailed plans must be avoided.

Digitized by Google

CHAPTER XIV

Defence Tactics

SINGLE-SEATER *v.* SINGLE-SEATER OR SINGLE-SEATER FORMATION

In the preceding chapters all considerations of tactics have been made from the attacker's point of view. In this and the following chapters the point of view of the quarry will be put forward and the methods by which aircraft defend themselves when in positions of tactical inferiority will be described.

The need for defensive measures may arise after a machine has been surprised or after it has become engaged with an enemy machine of superior performance or as a result of engine trouble or other circumstances which have given the enemy machine or the enemy patrol a position of strategical superiority which has made escape impossible. The best air fighters have been fully conscious of the importance of defensive manœuvring. "I do not believe in being shot about," says McCudden, "it is bad or careless flying to allow oneself to be shot about when one ought usually to be able to prevent it by properly timed manœuvres."

Let it be assumed first of all that our single-seater is surprised by another single-seater from the rear. The first thing of which the pilot of the attacked machine will be aware is the sound of a machine-gun close behind him. The action which is taken, and the degree of rapidity with which it is taken, will deter-

Digitized by Google

mine whether the attacked machine will save itself or not.

What are the courses which the pilot can adopt? He can pull up and zoom a short distance, he can dive, he can side-slip, he can roll, he can half-roll, he can spin, he can stall, he can Immelman turn, or he can turn. Of all these manœuvres, the most fatal is the dive. If the attacked machine dives, it presents, if anything, a better target than at first, and it will be helping rather than hindering the enemy. If it zooms it will still present an easy no-allowance shot and, at the end of the zoom, will be no better off than at the beginning.

If it turns, on the other hand, it will immediately present a more difficult target, for the attacker will need to change his aim and allow for his opponent's speed. If it side-slips it will also cause the attacker to alter his aim and allow for the sideways movement.

If the attacked machine executes a roll (a "whip" roll and not, of course, a slow roll) it will momentarily present an exceedingly difficult target. During the roll only a lucky shot would reach it and after the roll it is probable that the attacker would be already on his upward zoom. A roll reduces speed very markedly and therefore the attacker would approach his quarry at a combined speed in excess of that at which he would have approached it if the attacked machine had flown straight. The result is that the time available for the burst of fire is reduced. As a safety measure, therefore, the roll has many points in its favour; but it also possesses three great disadvantages.

First an aeroplane cannot be caused to whip roll very suddenly. An appreciable time is required before the stable condition, which is rolling, is assumed. If too much force is used to throw the aeroplane into a roll the wings might break. Secondly, during the roll, it is impossible to note the position and movements

Digitized by Google

of the attacker and to scan the sky for other enemy aircraft. Thirdly, at the end of the roll the machine is in no better position than it was at the beginning so far as replying to the attack is concerned.

The half-roll as a means of escape possesses the same first two disadvantages as the roll; it takes time to begin, and during the manœuvre observation cannot be kept. But the half-roll leaves the machine in a more suitable position for returning to the attack. After the half-roll the machine is upside down; it will dive out and, in so doing, pass underneath the attacker. A climbing turn may then bring the machine into a position from which a short burst of fire at long range may be delivered.

The spin, or the less known "falling leaf," are means of losing height and, when two single machines are engaged, should never be employed by either of them. Height in defence is just as valuable, as I already have shown that it was in the attack, and should be conserved. The stall, of course, is merely an exaggerated zoom and it has no better effect than a zoom.

While neither the turn nor the Immelman turn causes the machine to present so difficult a target as the roll or half-roll, they possess, as defence manœuvres, many important advantages and may be considered the best defensive manœuvres for use after a surprise attack.

The turn causes the machine to present a difficult target and, at the same time, begins bringing it into position for a counter-stroke. The turn allows the pilot to look round; to observe what type of machine has engaged him, to watch it closely and to notice whether other enemy machines are near at hand. Perhaps a moderate Immelman turn is better than a level turn because it can be initiated a shade more quickly; but otherwise there is little to choose as to which kind of turn is employed. A pronounced Immelman is to be avoided, however, for at the top there is a moment when the machine is stalled and therefore

Digitized by Google

not under full control. During a fight such stalled moments, however short, should be avoided.

The flat turn is also to be avoided for it must be remembered that a flat turn only causes the machine to *point* in a new direction at first while its flight path remains the same. The attacking pilot may see that a flat turn is being made and continue to shoot without making an allowance for a turn. The shots would then take effect. Even if the attacking pilot did not see that a flat turn was being made he would, in all probability, retain his no-allowance sight for a moment after his quarry had applied rudder. The flat turn must not be adopted in the first instance as a defence measure therefore.

A word must be added about the loop. Some people had imagined that, when an attack is delivered, the best defence is to loop so as to come out behind the opponent. While the loop, on certain rare occasions, has been used as a defensive measure, it will never be of value when a machine is surprised. Even assuming the speed is sufficient, it takes a moment or two to initiate a loop and, during much of the upward journey, the machine presents a splendid target for its adversary. Besides there is no reason why the attacker should not follow his quarry round the loop and come out behind him in a good firing position. The same thing may be said of the half-loop and half-roll out at the top and of upside-down flying.

After the first turn which will be made by the attacked machine, the attacker will have zoomed up and will be preparing for a second dive. Exactly the same process will be repeated when the second dive has begun and the enemy comes within range. Between each dive the attacked machine will climb towards friendly territory.

Assume now that a patrol of enemy single-seaters takes the friendly single-seater by surprise. Again the same manœuvre, a quick turn, will be executed at first. But then an awkward position arises, for

Digitized by Google

although the turn, if it be made sharply enough, may cause the leading enemy machine's fire to go wide, the remainder of the patrol will be coming down afterwards and will have plenty of time to judge the turn of the attacked machine and to "aim off" for it.

Therefore the single-seater will no sooner be clear of one machine than another will be dropping out of the sky on top of it with guns rattling. Obviously the attacked machine must attempt to escape. But again a note of warning must be sounded. The escape cannot be effected by diving. In a dive the controls become stiffer as the speed increases and manœuvrability is reduced. But manœuvre is the *sole defence of the single-seater*. To dive away after a surprise attack, is to sacrifice the great defensive powers of the single-seater without any gain. For, however fast the attacked machine dives, the attackers, since they possess an initial margin of height, can follow faster.

The single-seater has great powers of defence, it has been said, and this is no exaggeration. Although it is mainly an offensive instrument, properly handled, it can come through a perfect hail of bullets with very few bullet holes in the wings and with none near the pilot's cockpit or petrol tanks.

Therefore, when one single-seater is surprised by a patrol of enemy machines, the pilot must study to use his manœuvre so that (*a*) he is never flying in a straight line while any gun may be turned upon him, and (*b*) his machine never *appears* to be going in exactly the direction in which it actually is going.

After (but not during) the first attack, the flat turn may have uses. In fact, every known form of flying which causes the machine to proceed in a different direction to that in which it is pointing, is of value. But the whole time attempts will be made to gain height and to fly towards friendly territory, and every opportunity which presents itself for a brief spell of

Digitized by Google

straight flying will be utilized for these two purposes.

Of course, if a chance occurs for bringing down an enemy machine it should be taken—for the moral effect will strengthen the defence greatly. But when surprised, single-handed, by a large number of enemy craft the opportunity of retaliation very rarely offers for the average pilot, and he will be doing well if he reaches home safely.

When one single-seater is being attacked from the front or sides it will, if it is being taken by surprise, immediately make a sharp turn and try to pick up the attackers while manœuvring as violently as possible and avoiding straight flying even for the shortest periods. When it has observed the attackers it will retaliate with a short burst of fire the moment they are within range and the guns can be brought to bear.

If the single-seater is being attacked from the front or sides without surprise, it will attempt to obtain a burst of fire during the attacker's first dive. Thereafter the process will conform to one of those already described.

And now that the surprise attack has been considered, the defensive measures taken when the enemy has been observed but cannot be escaped from will be described.

Assume a single enemy single-seater to have been seen at a great distance diving towards the friendly machine, whether from the rear or from the front matters not. The pilot of the friendly machine will, if necessary, make a gradual turn until he is flying straight towards friendly territory, and then he will continue to fly straight, gaining the maximum *level* speed as if he had not observed the action of the enemy. When the enemy has dived to within a range of about 600 or 500 yards, the friendly machine will make a sudden climbing turn and, if possible, obtain a short burst of fire nose-on to the enemy (Fig. 16). These tactics invariably worry an attacking pilot

Digitized by Google

because he does not expect sudden retaliation; he is intent on the attack.

If the attacking machine is approaching too fast or too steeply to allow time for the nose-on reply, an opportunity will still present itself for a short burst of fire upon the tail or underneath the attacker (if he pulls out of his dive). In other words if the turn is made quickly enough and if it is rightly timed the

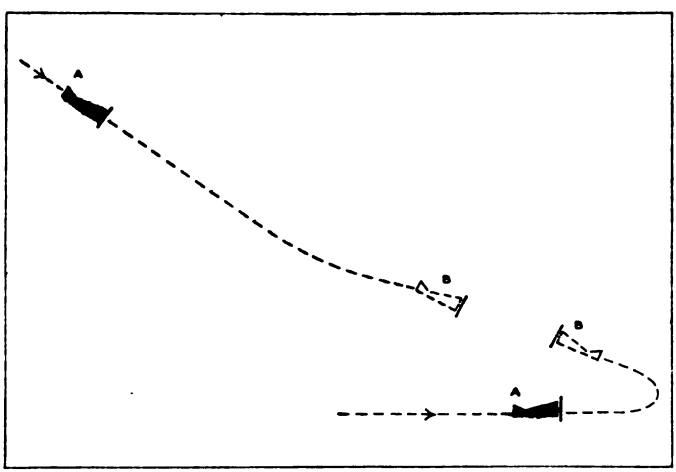


FIG. 16. Defence. Single-seater *v.* Single-seater.
A A: Dive of Attack.
B B: Quarry turns and delivers short "nose-on" reply.

attacked may turn the tables momentarily on the attacker with a resultant gain of moral superiority.

Having reached the stage where the first dive of attack has been completed the remainder of the fight will proceed upon the lines already laid down for the surprise attack.

The moral effect of the sudden nose-on retaliation is by no means lost upon a patrol of six or more machines, in fact it is often surprising how this show of boldness—materially almost ineffectual—will dis-

Digitized by Google

concert the enemy. Therefore, if our single-seater is being attacked by an enemy patrol and has watched the enemy closely, it will behave in precisely the same manner as has just been described for single-seater *v.* single-seater.

Of course if the attackers know their work they will pull out of the dive, execute an Immelman turn, and dive again as was described in the chapter on attack tactics. But even if they do so there has been a moral gain for the single machine.

When a patrol finally closes with the single machine the methods of flying already described will be adopted.

It must be noted that, given a certain difference in machine types, it is possible to escape from a patrol by diving with engine on *if the patrol is observed far enough away*. The difference in machine types must be: The single-seater will be a highly-loaded low-resistance machine, while the attacking patrol is composed of lightly-loaded high-resistance machines. If the pilot of the single machine is quite positive that this difference in machine types exists he may escape by diving. But it is a dangerous method to advocate; for, should judgment of the machine types be at fault, the patrol will close with the single machine while it is travelling at an extremely high speed, is incapable of rapid manœuvre and therefore defenceless

Apart from this one instance where the dive may succeed as a means of escape, diving is to be condemned for defence purposes. Spinning away and executing a "falling leaf" away is equally dangerous. No distance is gained towards friendly territory by spinning or falling leaf, and, if the patrol has followed the single-seater down it will take it at a great disadvantage when it "straightens out." It should be borne in mind that, while the enemy possesses superiority in height, he can nearly always catch his quarry.

Digitized by Google

Keep moving and keep climbing are the essence of defence tactics by one single-seater. As aircraft must imitate the tactics of birds in the attack so they must do in the defence. The butterfly cannot run away because it is not sufficiently fast, so it relies upon its exceedingly rapid powers of manœuvre. " J'imprimais à mon appareil des mouvements saccadés analogues à ceux qui permettent au papillon d'échapper à ses ennemis," says Fonck, describing his defensive tactics against enemy fire.

There is another point of very great importance in defence tactics which applies to all forms of defence, whether by one single-seater, two-seater or a formation.

The violent manœuvring during a battle and the intense watch which must be kept upon the opponents, demands so large a share of attention that it is quite impossible often to note in which direction lies the way home. There is no time to look closely at the ground below; and, even if it were possible to look at it, the compass is likely to be useless for the continual turning of the machine may have caused the card to spin and it requires a moment or so of normal flying for it to become steady.

It is essential that the direction of friendly territory be kept in mind the whole time, so that advantage may be taken of the moments when short dashes for home may be made. The only way to preserve an accurate sense of direction is by using the sun as a compass.

Whenever flying over enemy territory it is advisable to impress upon the mind the bearing of the sun to the machine for flying home, thus the smallest lull in the engagement may be turned to account to snatch a short distance. This means of direction finding is of double importance when a strong unfavourable wind is blowing; for the battle will then be likely to drift far over enemy country.

When clouds obscure the sun, the ground must be watched as much as possible during the combat and

Digitized by Google

therefore defence becomes increasingly difficult. In future wars the occasions are likely to be rare when a single machine is caught by an enemy patrol far over enemy country on a day when high clouds are heavy enough to obscure the sun.

Digitized by Google

CHAPTER XV

Defence Tactics

SINGLE-SEATER FORMATION *v.* SINGLE-SEATER FORMATION

The single-seater formation suffers from one great disability in defence; its power of manœuvre is limited. It has already been pointed out that a patrol leader must make the speed and climb of his machine conform to that of the slowest machine in the patrol, and this restriction applies during a fight. But the manœuvre of every machine is also limited by the need to avoid collisions and by the need to keep together. The result is that each individual pilot in a patrol has more to occupy his attention and is less well able to defend himself than if he were alone.

If a patrol is surprised it is necessary for it to strike a compromise between rapidity of manœuvre and the retaining of a close (in the war sense and not the peace-time or exhibition sense) formation. Both formation and manœuvre are bound to suffer. If the manœuvre is too much neglected the enemy will be given an easy target—or rather several easy targets. If the formation gets split up a machine may find itself with five or six opponents while the remainder of its own patrol are disengaged.

For a single-seater formation manœuvre is the only defence, and, therefore, if in its defence tactics one thing may be said to possess a greater importance than another, manœuvre is that thing. The aim should be for the machines in the attacked formation to be flying sufficiently far apart to give ample scope for manœuvre, yet near enough together to be

Digitized by Google

able to go to each other's assistance. If there are novices in the patrol, however, they should be instructed to keep close to the leader or sub-leader, above all else, for if they become isolated they will almost certainly be brought down.

It is important that the leader and sub-leader should carry streamers and have on their machines other striking individual markings so that they are readily recognizable as assembly points. The moments during which it is possible to look round for friendly machines during a fight are incredibly few and fleeting. The more boldly marked the machines the more readily will the formation reform and the more likely it is to keep together. As in the attack the first two machines in a patrol of six will, after the first shock, follow the leader and the second two the sub-leader ; so that two fighting units of three machines are formed (p. 116). The advantages of the fighting unit of three machines are described in Chapter X.

Assume that a patrol of six machines is attacking a patrol of six and that a surprise has been effected. The attack is being delivered from the rear with the friendly patrol leader as the focus. The friendly patrol leader cannot turn very sharply through 180 degrees because of the other machines in his patrol. He will turn of course as quickly as possible, yet allowing his patrol time to turn as well. The first resistance to the attack, therefore, will devolve upon the sub-leader and the two rearmost machines. (All three, it will be recalled, are higher than the leader.) The sub-leader will instantly fasten his machine to the leader of the attacking patrol and obtain as long a burst of fire as possible. If, however, the method of concentrated attack outlined in Chapter X is being employed by the enemy the burst of fire actually will be a very short one, for the sub-leader will himself be attacked only a fraction of a second after the leader.

When the sub-leader is attacked almost simultaneously with the leader he must temporarily abandon

Digitized by Google

the leader, taking with him the machines on his right and left. He must turn sharply through 180 degrees directly the first shot is heard. (He is able to turn thus sharply owing to his position. *See* Chapter II.) This turn will be imitated by the two machines detailed to follow the sub-leader and as a result of these manœuvres the "three" formation in a V facing to rear is at once automatically constructed. If the enemy has been foolish enough to open fire at long range, it may be that the friendly sub-leader will obtain an answering nose-on burst before they are close.

But even if the enemy withhold fire until the last moment, the turn as described will be an effective defence measure. The distance apart of the two threes which are then formed must not be allowed to become too great, for the whole object of the two threes in defence is mutual assistance between the groups at every renewal of the attack.

Upon the second dive of the enemy, which will have been observed and will therefore correspond to a first dive in an attack lacking the surprise element, the group of three attacked will turn and try to obtain a head-on burst of fire. The other three will approach, timing their arrival so that an effective fire may be directed against the enemy machines as they reach the bottom of their dive.

If the enemy patrol breaks up into two threes, then defence measures will practically conform to those employed by one single-seater. But, although the formation of three is less than half as unwieldy as the formation of six, it is naturally less mobile than the single machine. The threes should therefore keep spread out and, during the dives made by the enemy, every individual friendly machine should attempt to obtain a nose-on burst of fire. The whole time leader and sub-leader will attempt to keep their respective followers in view and to manœuvre so as to aid them and to ***gain height.***

Digitized by Google

If the friendly leader or sub-leader sees one of his formation isolated and liable to be attacked, he should immediately fly towards it. If the leader or sub-leader notices an enemy machine isolated he should instantly attack it.

All formation fighting causes a certain amount of confusion. For every single pilot there is observation to be done which could scarcely be effected by twenty men. The continual enemy attacks, the manœuvring to avoid fire and to avoid collision, the watch upon the leader, the watch upon the position over the ground: all these are in addition to the actual flying, which must remain at a fairly high standard, the sighting of guns (and perhaps the righting of gun stoppages). Much must be left to chance, and the pilot's object must be to turn one half of his attention to defensive manœuvring (and therefore to watching the enemy) and the other half to watching his leader.

As for the leader, his object must be to keep his patrol together, to gain height and to make towards friendly territory.

If the enemy machines continue to dive and to zoom until they have lost their margin of height, then a close engagement will result. In a close engagement the fighting is much the same as in single-seater *v.* single-seater; but the enemy is *never followed for any distance in any direction.* If an enemy machine is engaged and outmanœuvred and if he then dives away or attempts to climb towards the remainder of his patrol, he must be left, and the friendly machine must return to its own patrol. This rule applies even when—or, perhaps it should be said, especially when—there seems a chance of bringing down the enemy machine by chasing it a short distance. The absence of one machine weakens the patrol too much to be allowable longer than is essential.

Until supremacy has been established by outmanœuvring an enemy machine, all thoughts of the patrol must of course be abandoned by the individual;

Digitized by Google

but usually in the duel one or the other pilot will get the upper hand in a very short period and the remainder of the patrol will not be out of sight when the subsidiary combat reaches a decisive point. If the enemy machine obtains the upper hand all that the friendly machine can do is to keep up its defensive manœuvring and to hope that assistance will arrive: it cannot hope to make its way back to the patrol while it is engaged in defending itself.

One more point is this: If an enemy machine is isolated from the rest of its patrol and dives down far below the fight, it is usually, though not always, a mistake for any single friendly machine to follow it down.

On the occasion when the first big aerial battle of the War was fought, an entire British wing went out in three gigantic layers and met and fought for about half an hour with what was always thought to be von Richtofen's Circus and with several other German patrols. During the engagement the topmost patrol of single-seaters in which I happened to be, was fighting enemy machines of about equal number (any attempt at estimating exactly the numbers would be mere guess-work, for it was quite impossible to count so many machines during the whirl of combat).

During the course of the fight I saw an enemy machine dive far below us. Immediately one of our patrol detached and followed. I lost sight of the machines for a moment owing to the pressing need for outmanœuvring an enemy single-seater and, when I glanced down again, I saw another enemy machine behind our own one and our own machine was in flames.

It is quite impossible to say where the second enemy machine came from. In those battles it was impossible to get a clear idea of the course of events at all; but the incident demonstrated the inadvisability of following a machine down when it is known that other enemy machines are above. While a single-seater is

Digitized by Google

in the act of shooting down an enemy machine it is, perhaps, more vulnerable itself than at any other time.

All the turns of defensive tactics by a patrol against another patrol which are not dealt with under other headings, have here been examined. The subject becomes too indefinite beyond a certain point in the combat. It is to be understood, however, that if the patrol is larger than those indicated in the descriptions, exactly the same principles will be adopted.

A few remarks must now be added upon layer patrol defensive tactics and upon defensive tactics for frontal attack.

For defence as for offence, the layers must not be too far apart. Fonck's attack on the layer patrol described elsewhere, would have been far more risky if the layers had been close enough together to allow the topmost machines to come within range before he had escaped.

Suppose that the lower layer of a two-layer patrol is being attacked from the rear. It will be the duty of the upper patrol (size does not matter) to drop on the attackers a fraction of a second before they come within range of the lower patrol. First, however, the upper patrol must make very sure that the sky above them is clear; for if the enemy is also formed in two layers, then each layer engages with the corresponding one on the other side.

Suppose, now, that the top layer is attacked. Its best policy is to take every available opportunity to close with its lower layer. It cannot afford to dive while the enemy is actually shooting, but between each attack it should be able to move closer. Once the layers have joined together, there is one large patrol which, in principal, will behave as described for the patrol of six. If the top layer is attacked on the level, however, even by superior numbers it should not sacrifice height in order to join the lower layer. By sacrificing height it will put itself into a position of

Digitized by Google

strategical inferiority and until it reaches the lower layer it will be vulnerable.

In an attack on the level the patrols will, of course, both adopt *offensive* tactics so that further consideration to that form of fighting need not be given here.

In the attack from the front or sides the object of the defence, whether layer patrol or not, will be to steer so as to *approach* the enemy patrol and thereby to lessen the time during which the enemy may fire. Naturally the nose-on reply to fire will be used if possible; but where it is not possible the friendly patrol must defend itself by approaching the enemy at full speed but without losing height.

After a battle, the patrol leader should collect all his patrol before going far from the scene of combat. But if one or more of the patrol are missing, then the patrol leader should carry out a series of tours in order to make certain that the missing machines are not still engaged with the enemy and in need of assistance.

Digitized by Google

CHAPTER XVI

Defence Tactics

ONE OR MORE MULTI-SEATERS *v.* SINGLE-SEATER FORMATION

Frequently the single two-seater must face six or more single-seaters. One of the two-seater's tasks is artillery observation, and since artillery observation must be accomplished near friendly territory no escorts are provided for machines engaged upon it. Again the single long reconnaissance two-seater which carries out photography or observation from a great height may be attacked by a formation of fighters far over enemy country. The observation machine is not escorted because it relies upon height to do its work without being seen, or, if it is seen, it relies upon height to allow it to escape.

The basis of defensive tactics by a two-seater, whether against superior numbers or, if against a single machine, is close co-operation between pilot and observer (or gunner as he frequently is called). Pilot and observer should know each other well. All airmen who fight should know the other airmen who fight with them in formation, but the pilot and observer of a two-seater must know each other intimately.

There must be a complete but extremely simple code of signals between them. If the observer sees enemy machines approaching he must be able instantly and clearly to impart the information to his pilot. Simple signals were used in the War and pilots and observers may be permitted to use their own system. To lay

Digitized by Google

down a regulation pattern of signals would be a mistake; for the eventual result would almost certainly be complication and *complication must, at all costs, be avoided.*

The same pilots and observers should always work together. This is a point which is often in danger of being neglected by commanding officers. It is said that a trained observer should be able to work with any trained pilot and that signals must be standardized. This is really the application of military principles to the air. No doubt pilots and observers could fight quite well under military conditions, but they could not fight with the inspiration necessary for great success.

For purposes of illustration it will be assumed that the pilot operates two fixed guns firing straight forward in the line of flight, and that the observer has two guns on a movable mounting. The observer can turn his guns in any direction and his field of fire is limited only by the wings, tail plane and fuselage, etc. of his own machine.

Now there is always in two-seater fighting the question of who shall do most of the shooting. The pilot can decide. He may choose to fight his machine as if it were a single-seater. He may attempt always to bring his own fixed guns to bear upon the enemy. Or he may disregard his own guns and strive only to give his observer good opportunities for shooting. At present the most prevalent idea is that the observer should be regarded as the gunner and not the pilot; but it must be remarked that several pilots have successfully fought in two-seaters as if they were single-seaters, and the method requires careful consideration before it can be discarded.

Anyhow the pilot must have one or other method definitely fixed in his mind. It is useless to attempt to combine the two methods. Confusion and uncertainty of manœuvre are sure to result. With low performance two-seaters it would seem, upon theoretical

Digitized by Google

examination of the question, that the observer should do the shooting, and it is upon this hypothesis that the defensive tactics of a single two-seater against a formation of single-seaters will first be explained.

Assume that a single two-seater is engaged upon artillery observation near friendly territory. The pilot will probably be doing the "observing" and will be signalling the gun corrections by wireless to the gunners. He will be flying on a more or less regular course and a large part of his attention will be fully occupied. The observer will watch the sky for hostile aircraft.

It is unlikely that the artillery observation machine will be flying high, so that the chief danger of attack, though not all the danger, will be from *above*. The observer will therefore intently examine the sky upon some regular system. He will mentally divide it into portions and will examine each portion in regular rotation giving a shade more attention to the sky above. When the entire air, both above and below the machine, has, as far as possible, been covered, the observer will start his look-out at the beginning again. This system will be continued for the entire duration of the patrol.

When he sees in the distance an enemy patrol diving to attack, the observer will immediately warn the pilot and will then prepare to fire. If the enemy single-seater patrol is diving on the tail of the two-seater, the observer should open fire just *before* they come within range rather than after, this being one of the rare occasions when it is a mistake to withhold fire. He should select the leader of the enemy patrol as his target and he should continue firing until the enemy machines pull out of their dive either to renew the attack or to go away.

As they pull out of their dive the observer's best chance comes. The single-seater patrol in retreat will present their tails or flanks to the observer's guns. The nose of a single-seater, it has been pointed out

Digitized by Google

already, is virtually armoured by the engine; but, as the single-seaters are making their escape, they are almost sure, if they are above the two-seater, to present some vulnerable part to the observer's guns.

The observer should swing his guns as rapidly as possible as the single-seaters pass overhead or to one side and should attempt to bring an effective fire to bear before they are at extreme range. The moment is a fleeting one as the single-seaters are travelling at very high speed.

Meanwhile the two-seater pilot, after having been warned of the enemy's approach by his observer, may adopt one of two courses. He may manœuvre violently with the object of presenting as difficult a target as possible during the dive of the single-seaters, or he may merely put his machine into a gentle turn and trust to the effect of his observer's fire. Probably the best method is for the pilot to manœuvre violently while the single-seaters are diving and then to steady his machine directly the single-seaters start zooming on their retreat. The observer will have little chance of bringing effective fire to bear while the single-seaters are diving; but, when his best opportunity occurs, while they are zooming, he will be firing from a steady platform.

Assume now that the single-seaters engage in in-fighting with the two-seater. One will almost certainly attempt to reach a position close beneath the two-seater. The two-seater pilot will turn and watch for opportunities for his observer. He may reduce the air speed of his machine whenever good chances for his observer to fire present themselves. This method, of course, consists in closing the engine throttle a certain amount and pointing the nose of the aeroplane upwards. The observer then contends with a reduced wind pressure upon his guns, and gains, it is argued, an increase in the accuracy of his fire.

The gain of accuracy in the observer's fire is counter-balanced by the loss of speed of the machine. This

Digitized by Google

loss of speed assists the enemy machines to a certain extent both by allowing them more readily to reach whatever positions they desire and by giving them an easier target. However, speed would not be reduced for a long period and the method would be resorted to only when the pilot was convinced that his observer would benefit thereby.

When the pilot fights his two-seater as a single-seater, it is clear that his tactical manœuvres will conform to those described for a single-seater. The observer meanwhile will take every opportunity to obtain bursts of fire at the enemy machines as they pass and repass.

The pilot of a two-seater, upon being attacked by a formation of single-seaters, will naturally make his way over friendly territory as quickly as possible. It would be foolhardy deliberately to remain amidst a formation of single-seaters, for there is little chance that he will do much execution and a very great chance that he will be brought down.

The long-distance reconnaissance two-seater, if it be caught by a formation of enemy single-seaters, will behave in very much the same way as the artillery observation machine, with one or two exceptions.

The pilot and observer of the long reconnaissance machine will search the air below them for enemy machines with as much diligence as they search the air above; for they will be flying high.

The question of whether or not the pilot fights his machine as a single-seater depends very largely upon the machine itself. A long reconnaissance machine, as compared with an artillery observation machine, possesses a high performance. It has climb and speed and it may have a certain facility of manœuvre.

Now the pilot should decide if he will fight his machine as a single-seater or not according to whether it possesses great powers of manœuvre or not; and also, to a less extent, according to whether the majority of

Digitized by Google

single-seaters which the enemy are known to be using possess great powers of manœuvre or not.

There is little doubt that, if a two-seater is capable of rapid manœuvre and good performance it is a strong instrument of both attack and defence when it is fought as a single-seater. In fighting as a single-seater the pilot should completely disregard his observer as far as manœuvring is concerned. He should leave the tail protection to the observer.

When it is attacked the defensive tactics of a long reconnaissance machine closely resemble those of the two-seater artillery observation machine or, if the single-seater method of fighting is chosen, of one single-seater as described in a former chapter.

Some of the defensive manœuvres employed for a formation of two-seaters when attacked by a formation of single-seaters (or of course by one single-seater or by another formation of two-seaters) differ from the defensive manœuvres employed by a single two-seater.

In the first place, in formation great freedom of manœuvre is impossible. A two-seater formation of six machines could, therefore, either split up into two groups of three each (as did the single-seater formation) or it can resign itself to presenting a fairly easy target and place the responsibility for defence against attack from the rear upon the observers.

The second method, that of using the observers to defend, is the better. The two-seater formation, if it keeps close together (rather closer than would a single-seater formation) can cover any enemy machine which approaches within range from the rear with one or more guns. The pilots of the two-seater formation will perhaps "S" bend gently, but they will otherwise leave the defence of the rear to their gunners.

In order that the defence of a two-seater formation may be delegated to the observers, the disposition of

Digitized by Google

the patrol should be so modified as to allow the observers to bring cross fire to bear upon a target behind and generally to permit the maximum use to be made of the rear guns.

The gunners will behave exactly as described for the artillery observation machine gunner; but they will in addition pay particular attention to other machines in their own formation and will direct fire instantly at enemy machines which obtain positions under the tails of those other machines.

And now defence against attack from the front launched against one or more two-seaters may be considered generally. If the underneath wing-tip attack described in Chapter XI is being employed by a formation of single-seaters it is exceedingly difficult for the pilot of the two-seater to escape putting himself in a dangerous position. If he turns to give his observer a chance to fire the attacking single-seaters will bring up in an ideal position under his tail. If he cannot see the attacking single-seaters, however, he *must* turn, for no other course is open to him. His best procedure, then, is to turn sharply through a complete 360 degrees, unless, during the turn, he observes an opportunity to present itself which could be taken advantage of by changed tactics.

If, on the other hand, he has watched the attackers diving down at one side during the initial stage of their attack, the two-seater pilot's best policy will be to point the nose of his machine down and to attempt to obtain a short nose-on burst at the zooming enemy single-seaters. As a general rule a turn always gives the observer an opportunity to bring fire to bear upon one enemy machine at least. But it should be remembered that it is important to concentrate fire upon the closest or the most dangerous of the enemy machines. It is thus of little advantage for the observer to shoot at an enemy machine flying above at 300 yards range while another enemy machine

Digitized by Google

is attacking below at 100 yards range. *The immediately dangerous machine must first claim attention.*

When a formation of two-seaters is attacked from below and in front by a formation of enemy single-seaters, the leader of the two-seater machines, if he has observed the enemy, will put the nose of his machine down and, with all his patrol, return fire nose-on. This method would probably demand a very steep dive from the two-seaters, and it tends to scatter the formation a little; but it is the only really effective reply to the under wing-tip attack.

If the two-seater formation is taken by surprise in an attack from under the wing-tips, the leader should turn in what he judges to be approximately the direction from which the enemy machines are approaching. Thus attackers and attacked will be approaching each other, and therefore less time will be given to the attackers in which to shoot.

As a general summary of two-seater defence tactics it may be said that, when alone, a two-seater may be fought as a single-seater if it possesses a very high performance and marked powers of manœuvre. When in formations two-seaters should always be fought *as* two-seaters. That is, the pilots should aim at giving their observers as many chances as possible to obtain effective bursts of fire at the enemy.

Of course when it is said that two-seaters will be fought thus to give the observers opportunities, it does not infer that the pilot's guns are not used. Every opportunity which presents itself and which can be taken without materially affecting the observer's shooting, should be taken.

For the sake of completeness it may be added that F.E.'s, the old "pusher" two-seaters, are used on occasions to employ a special form of defence tactics. They used to form a large circle and fly round and round when they were attacked. Thus the observer (situated in front, of course, in an F.E.) of each machine covered and protected the vulnerable tail of the machine in

Digitized by Google

front. These tactics might be employed by two-seater tractor machines, but they are clumsy tactics. They do not permit the machines to make way in the required direction, nor do they add to the chances of bringing down enemy machines.

The very important subject of defence tactics by a formation of bombing aeroplanes when they are attacked by a single-seater formation will now be examined.

The bomber is a weight-carrying aeroplane and it has a definite course which it must follow. Since it is designed for weight carrying it is rarely found that it possesses high powers of manœuvre. Its powers of manœuvre at an altitude close to its ceiling are far less when it is loaded than when it is flying light, but, whether loaded or light, it is ordinarily quite incapable of competing in manœuvre with single-seater or with two-seater.

The bomber's course is set when it goes out, and often the distance to be traversed in order to reach the required objective is so great that but a small margin of fuel will remain after the double journey has been completed. It will be seen therefore that a formation of bombers would instantly put itself at a grave disadvantage if it allowed itself to become embroiled with enemy fighters. First it would be outclassed in manœuvre and performance, and secondly it might use up so much fuel during the combat that insufficient would remain for it to fly back to its base.

Bombing machines therefore must fly as they fight; they must deviate from their course as little as possible and must rely almost entirely upon gun-fire for protection. It is for these reasons that it becomes doubly important so to place the gunner's cockpits in a bombing aeroplane that there shall be no blind spots and so to dispose the machines in the formation that cross fire can be brought to bear against targets in the rear.

The raids upon London by German bombing aeroplanes during the War were executed with full com-

Digitized by Google

prehension of the correct defensive tactics for a formation. These tactics may be summed up thus: fairly close formation must be retained throughout the engagement, defensive manœuvring must be reduced to the minimum and protection must be left in the hands of the gunners.

Thus, if a bombing formation on the way to its objective be attacked by a single-seater formation, it will keep straight on, and, when the single-seaters approach within range, it will bring every possible gun to bear upon them.

But again a clear system must be understood by all the gunners. They must know when to concentrate fire upon one of the enemy machines and when to scatter it. The rule is simple. *Fire must be concentrated upon the leader of the enemy patrol until that patrol breaks up into two formations of three each or scatters completely.* In the first attack then all the bomber gunners who can bring their guns to bear will fire at the leader of the enemy patrol. If, as it may do, it intends to adopt in-fighting tactics, the single-seater patrol divides into two sets of three each (or three or four sets according to patrol size) the bomber gunners must again apply a definite system of co-ordinating their fire.

Again the system is simple. The individual gunners all fire at the leading machine of the formation of three nearest to them. If the attack be delivered from two directions at the same moment, as described in Chapter XII, therefore, the attackers will all be met with fire. So long as the attackers preserve formation, whether in groups of three or in mass, *the leaders of each group only must be made the targets.* The reason for this concentration upon the leaders has been explained already, it is to disorganize the attackers. So long as the attackers remain organized the bombers will be seriously troubled by them and may lose machines, but when once disorganized, the fighters become less formidable.

Digitized by Google

The need of watching the sky applies to the gunners and pilots of bombing aeroplanes with as much force as it does to the pilots of other machines. The leader of a bombing formation, however, must direct most of his attention to holding his formation together (this he does, of course, by alterations of speed and course). Every pilot in a bombing formation must have precise instructions as to his actions in the event of the leader being shot down. He will be told to form round the sub-leader and how to turn in order to effect the re-formation with a minimum of disorganization.

Multi-seater defence tactics largely depend upon the question of which guns, the pilot's or the observer's, are to be given precedence. In bombers the observer's (or gunner's) guns are clearly the only ones that can be used with effect. In two-seater artillery observation and in long reconnaissance machines it is a matter of individual choice; but the observer's guns are, perhaps, more likely to obtain the required defensive effect. In two-seater fighters the pilot's guns may be given precedence although, even here, a definite ruling is impossible.

Digitized by Google

CHAPTER XVII

Defence Tactics

ANTI-AIRCRAFT FIRE

Before closing these remarks upon defence tactics in the air, it will be necessary to touch briefly upon the means which may be employed for reducing, as much as possible, the risks from anti-aircraft fire. In this branch of tactics no special knowledge or experience is required, for common sense dictates the right course. Yet, in spite of the obviousness of the nature of defence tactics against anti-aircraft fire, a large number of pilots refused to take any measures to reduce the risks of being hit during the War. The high percentage of these reckless ones who paid the penalty being brought down by direct hits, proves that the need of defensive tactics exists.

There are three kinds of anti-aircraft fire which will be considered. One is fire from guns, one from rifles, and one from machine-guns. Aircraft may be shelled by guns at great heights. Possibly progress in gun design may be able to keep pace with progress in aircraft design, so that as aeroplanes are made which can reach greater altitudes, so anti-aircraft guns will be improved and their accuracy of fire at extreme ranges will be increased. But the picking up or "spotting" of an aeroplane at a very great height is the essential preliminary to anti-aircraft fire and, at 40,000 or 50,000 feet, at which heights no doubt single-seaters will operate in the next big war, it should rarely be possible to spot an aeroplane from the ground.

Digitized by Google

Bombers and two-seater observation and artillery machines, however, will be forced by the nature of their work, to operate within sight of enemy anti-aircraft gunners, and single-seaters will, of course, frequently fly low; it is therefore advisable for all pilots to practise some system of "dodging."

First it must be understood that under many conditions the first burst of fire from the ground, as the first burst from another aeroplane, is the most dangerous. This is partly because the aeroplane, whose pilot is not expecting to be shot at, is flying straight at a steady speed and without altering height. The corrections of the A.A. gunners will therefore have the effect required, and if the gunners have judged range, speed and direction rightly, a direct hit should result. The pilot, when approaching enemy country, should bear in mind, therefore, that he may have been seen and that if he flies straight and level, he is giving the enemy gunners the best opportunity to range upon him.

The "dodging" must start before the pilot is over enemy country or within range of enemy guns. This dodging consists in an occasional alteration of course and of height and of speed. These alterations need not be violently made nor need they be of great extent. After the bombardment has opened and all the time the machine is being subjected to A.A. fire, or is flying within range of enemy guns, the pilot should continue frequently to alter course, speed and height.

Naturally the bomber and the long reconnaissance machine is restricted and cannot make any but the slightest alterations, but these should suffice; indeed some say that these slight alterations as they are sometimes unobserved, so they are the more effective. The leader of a formation will take exactly the same steps for protecting his patrol as he would take when flying alone, but the individual machines may also make small turns and slight reductions or increases in speed

Digitized by Google

without losing station in the patrol if their pilots think it advisable. When machines are flying near their ceiling, very gentle turns are the only protective devices which can be employed, for alterations in speed and height cause height to be lost which only with difficulty can be regained.

The state of the weather has much to do with the accuracy of anti-aircraft fire. It is common knowledge that, on a perfectly fine day, with no clouds but with a slight haze the danger of being hit at any height is not great. When the sky is clear, except for occasional floating clouds, and there is no haze, the shooting will be rather better. But when there is a high layer of clouds and no blue sky or sun or haze, the shooting is at its best.

When flying low, anti-aircraft gun fire is usually inaccurate, and when flying only just above the trees and houses its effect is not worth consideration. Low down another kind of anti-aircraft fire comes into play and becomes serious. This is rifle fire and machine gun-fire. These are dangerous when attacking trenches and aerodromes, and since the time taken by the flight of the bullet is small, dodging, as it is practised high up, is almost ineffective. High speed does, however, act as a protection.

"Flaming onions," gas and phosphorous anti-aircraft fire during the War, proved ineffective, and, although some of the huge rolling billows of smoke, produced, it was thought at the time, with phosphorous charges, must have had a moral effect, they seem never to have produced a material effect.

Against night-flying aeroplanes networks of balloon cables were occasionally used in order to protect towns. Against this kind of thing at night, no defensive action can be taken; it is simply a matter of trusting to luck. A protective device against balloon cable barrages for use on "pusher" machines and on certain twin-engined machines was, however, produced. It consisted in a "bowsprit" jutting out

Digitized by Google

in front of the aeroplane. A heavy steel wire was then led from one wing-tip, to the point of the bowsprit and then to the other wing-tip. Thus a V was formed in front of the machine which was intended to deflect any balloon cable which might be encountered in the dark. The device was actually tried at the experimental station at Orfordness and proved successful. An aeroplane was intentionally directed by its pilot at a balloon cable. The protective V of the wire deflected the cable and the machine was undamaged, save for a small cut in the leading edge of one wing.

Apart from such mechanical devices, however, no tactical defensive measures can be taken against balloon cable barrages.

Aeroplanes designed for low flying also have had their pilots, petrol tanks, and parts of the engine armoured (the Sopwith Salamander was an example) as a defensive measure against rifle and machine-gun fire; but here again there is no special tactical manœuvring required and the defence has to be entrusted to chance and the armour being in the right place.

A note must be added on the employment of anti-aircraft fire as a signalling device. If anti-aircraft gunnery is seen to be grossly inaccurate when the weather conditions are favourable to the A.A. gunners, it is advisable to make special search for enemy aircraft and to observe if the cloud conditions make it possible for enemy machines to be flying above a cloud which could obscure them from view of the pilot of the friendly machine but which would not prevent them from seeing the shell bursts.

Speaking of a trap which was laid with the help of A.A. fire, Bishop says: "It was while flying just under the clouds, I suspected a trap, as the machine with which I was fighting did not seem particularly anxious to come to close quarters, so pulled my machine back and zoomed up through the clouds. The layer was very thin and I suddenly emerged in the blue sky

Digitized by Google

on the upper side, and just as I did so, I saw the last of a group of German scouts diving vertically. A little to one side there was a huge black burst of German high explosive. The whole thing was obvious to me at once. The pilot under the clouds had led me to this particular spot, while the people above had been signalled when to dive through to get me."

This description gives a sufficiently lucid explanation of the use of A.A. fire for signalling, the method requires no further comment.

Digitized by Google

CHAPTER XVIII

AERIAL GUNNERY

ALTHOUGH strictly foreign to the subject of the Strategy and Tactics of Air Fighting the question of shooting, as apart from when and where to shoot, demands brief consideration here in order to round off the subject. Fighting pilots often found that, after dangerous and arduous experience had given them a fairly complete understanding of strategy and tactics, they were unable to achieve victories owing to their inability to direct their fire accurately. This state of affairs was very regrettable, for every time these pilots went out on patrol they bought their knowledge of strategy and tactics with risk, yet having assimilated that knowledge and survived the feat, they were still unable to put it to practical use by bringing down enemy machines owing to the inaccuracy of their fire.

It must be recalled that a pilot learnt to fly and went to France without possessing the remotest understanding of the science of fighting in the air, already a science more complex than fighting on the ground or the sea. If they were lucky enough to survive two months at the front, they were beginning to learn how to defend themselves and it was commonly accepted that their chances of surviving for a further four or six months were then greatly increased.

If they were intelligent they learnt during the following six months something of the rudiments of the strategy and tactics of attack and they were then ready to attempt to bring down enemy machines.

Digitized by Google

It will be seen that the pilot's knowledge was gradually acquired and in proportion as he increased in knowledge so his own safety became more assured and the likelihood of his bringing down enemy machines grew greater. This was simply because pilots started their fighting careers in a state of complete ignorance of air fighting. The expert fighters were not vocal and, although they knew how to fight themselves, they were unable or unwilling to impart that knowledge to others. Therefore the first two months of a pilot's fighting career were appallingly dangerous.

But, if he came through those first two months and a further six months safely, his acquired knowledge was still often of small value to him and he spent much time trying to discover why, when he successfully approached enemy machines in complete secrecy and surprised them in a suitable position, he still failed to bring them down. If he was intelligent, he saw, like McCudden, that it was his shooting that was at fault and he set himself the task of learning how to shoot in the air. During the period of learning he exercised his acquired knowledge of strategy and tactics (which even yet was probably elementary) in protecting himself and keeping alive on patrol.

Now it is clear that the first principles of strategy and tactics in the air may be impressed upon the pilot before he enters the field of battle, so that his first experiences of aerial warfare will not be fraught with the overwhelming dangers they were in the last War. But even so he goes up insufficiently armed if he has not learnt to use his gun. Gunnery, therefore, should be taught at the same time as strategy and tactics.

In teaching gunnery it should be understood that it must be taught *in the air*. It used to be the practice to use clay pigeons to be shot at with ordinary shot-guns from the ground as a means of training the shooting of the pilot. This indirect method may have produced a slight effect, but if so it was very slight. All kinds of rifle, shot-gun or revolver practice on the

Digitized by Google

ground are of little practical use as a means of training for aerial gunnery. Even the elaborate systems of ground practice for aerial gunnery established at Paris Plage and near an aerodrome in Scotland were almost useless.

At Paris Plage a light railway track was laid out in an oval and an electric car ran along this track. In the electric car an observer's gun ring was mounted and on it was a machine-gun with observer's sights. The target consisted in a large piece of material with an aeroplane painted in the middle of it and stretched on a frame. This target was mounted upon another car which ran along a separate track; thus the marksman and target were moving and turning at different speeds and in different directions and allowances had to be made in the sighting for the speed and directions of both the gunner's car and the car carrying the target.

This device probably assisted in improving the gunnery of observers, but it certainly had but little if any effect upon the gunnery of pilots. The means used for obtaining the maximum possible realism on the ground in a representation of aerial fighting, were extremely ingenious; but they did not give the same effect. For example, the 100-mile-an-hour gale that may press against the observer's gun and which may suddenly calm down to 60 miles an hour as the aeroplane is manœuvred, could not be simulated closely on any gunnery range upon the ground.

In short it is necessary to send men into the air in order to teach them aerial gunnery. In the air there are many means of providing a realistic target which calls for all the shooting allowances needed in aerial fighting. One means is the towed target. The towed target has not been used extensively owing to the danger of the machine which is doing the towing being hit by stray shots. The towed target has, however, been used for practising "upward" shooting (a special kind of defensive gunnery).

Digitized by Google

Then there is the shadow target. The aeroplane flies over a lake or river and the observer shoots at its shadow on the surface of the water. This is the most effective method if *two* machines are employed, one to make the shadow—the other to practise shooting. By means of shadow shooting both pilot and observer can practise from a machine in flight. They shoot at something which in its movements very closely resembles a machine in flight, the course of which they cannot foresee, and they can see by the splashes in the water whether their shots are taking effect or not.

Another form of target is the sand target on the ground, made to resemble the shape of a aeroplane in plan. This form of target is, for obvious reasons, inferior to the shadow target, although some of the best fighting pilots trained themselves almost exclusively upon it.

Now that wireless control of aeroplanes is possible it should be of great use in training pilots to shoot, for a real aeroplane (with its vital parts armoured) could be sent up as a target. However, satisfactory training could be effected by the use of the shadow shooting already described coupled with mock fights between machines armed with "cinema guns."

The ordinary single exposure camera gun which requires reloading between each "shot" does not give the effect of machine gun fire sufficiently closely for training men in aerial gunnery. But a cinema gun could easily be perfected which would record, in a series of photographs the airman's accuracy or inaccuracy of fire. Experiments were being conducted several years ago with cinema guns and while at that date they got out of order too readily for them to be issued to service squadrons, nowadays it should be a simple matter to design and produce a suitable one.

Mock aerial combats, although they do not reproduce

Digitized by Google

active service conditions, are an exceedingly valuable form of training even when no cinema cameras are available to give graphical proof of who has "won." These two methods, the shadow-shooting and the mock combat with cinema guns, should be used for training pilots and observers to shoot while flying. Ground practice has but small value for it is the little troubles and difficulties which crop up only in the air that make all the difference between good shooting and bad. "What happens during those few seconds," says "Contact," describing an air fight from the observer's point of view, "may depend on a trifle, such as the position of the gun mounting, an untried drum of ammunition, a slight swerve or firing a second too soon or too late."

Aerial gunnery is difficult; and in order to attain proficiency long practice is needed. For it must be remembered that the pilot must fly his machine at the same time as he is shooting, and although aiming and flying are both co-ordinated and together effected, in a single-seater by the control stick and rudder, yet the pilot must have always present in his mind two clear conceptions. One of the attitude of his aeroplane; and, two, of the position of the enemy machine in his sights.

And now consider the types of ammunition. There are five kinds: ordinary, armour-piercing, tracer, incendiary and explosive. In the Declaration of St. Petersburg, 1868, the contracting powers (amongst whom was Great Britain) agreed to renounce projectiles of a weight below about 14 ozs., either explosive or charged with fulminating or inflammable substances. Expanding bullets, again, were prohibited at the Hague in 1899. Tracer, ordinary or armour-piercing ammunition was permissible, but, during the latter half of the War, explosive and incendiary ammunition also were used by both sides. Chiefly explosive and incendiary ammunitions were used against balloons and airships; but they often were used against

Digitized by Google

aeroplanes. In 1923 at the Hague therefore the jurists removed the bans on explosive and incendiary ammunitions when used by or against aircraft. The legal aspect is examined at length in "Air Power and War Rights" by J. M. Spaight, but here, in considering ammunition, all kinds must be included.

Ordinary ammunition may be used always, although its very lack of special qualities makes it of less value to the airman than the other kinds. Thus, if neither tracer nor incendiary nor explosive ammunition are used, armour-piercing bullets would at least give a better chance against a greater number of machine types than ordinary ammunition.

Tracer is useful, and, after much practice with it, an airman may obtain a fair estimate of the accuracy of his fire. Incendiary ammunition must be used against balloons. Most pilots and observers, in spite of the 1923 decision at the Hague, will probably prefer not to use it against other aeroplanes although the general fitting of parachutes makes the use of incendiary ammunition against aeroplanes less terrible. Similarly with explosive ammunition. It will be used against airships and balloons but not, if possible, against aircraft.

For ordinary patrol work the kind of ammunition favoured in the War was a combination of armour-piercing and tracer. The linked machine gun-belts were charged with one tracer and three armour-piercing in every four bullets or some similar apportionment. For balloon attacks the belt was often charged with 20 or so rounds of ordinary ammunition, then perhaps 50 incendiary bullets and the remainder the mixture of armour piercing and tracer already mentioned.

The object of this arrangement was this: The first 20 rounds were for waste purposes in testing the gun and manœuvring preceding the attack. The 50 rounds of incendiary were for the balloon, and the remainder of the ammunition was for use in the event of

Digitized by Google

a fight against other aeroplanes after the balloon attack.

Perhaps, during the greater part of the War, the dislike of charging the entire gun-belts with all incendiary ammunition even when balloon attacks were to be launched, was, in part, due to the fear held by the airman of being shot by a firing party on the ground if engine failure necessitated a forced landing in enemy country. It was said that if a machine landed and was found to contain incendiary or explosive ammunition, the pilot and observer were immediately shot without trial. But although this reported treatment, no doubt, weighed with many airmen and caused them to take as few rounds of incendiary or explosive ammunition as possible, the majority were possibly also actuated by the desire not to inflict unnecessary suffering upon their opponents.

There is, however, a further cause for limiting the number of rounds of explosive or incendiary ammunition carried by a fighting aeroplane. Most kinds of special ammunition are less accurate than ordinary or armour-piercing ammunition. Even tracer is supposed to be inaccurate compared with armour-piercing. Therefore the pilot and observer have practical beside humanitarian reasons for loading their gun belts with ordinary or armour-piercing bullets in the majority. If circumstances arise which make it necessary to use incendiary or explosive ammunition it is still advisable, for the sake of accuracy of fire, to retain a heavy sprinkling of armour-piercing bullets. It is always possible however, that new kinds of incendiary and explosive bullets may be invented which are as accurate as armour-piercing bullets.

Many people wonder why larger guns are not used in aeroplanes, and why such armament as the special aeroplane gun which fired a 1½ lb. shell, does not replace the conventional two or four machine-guns. The answer is that rapidity of fire is, at present, much more important than weight of projectile. It is so

Digitized by Google

difficult to hit another aeroplane from an aeroplane that a jet of lead is required if there is to be any certainty in the gunnery. When and if large guns are made which can fire as quickly as small ones, there will be need to reconsider the air armament question.

Digitized by Google

CHAPTER XIX

FLYING TRAINING AND MORAL

THAT a good pilot need not necessarily be a good fighting pilot has been claimed by many airmen. But as it has been said a good pilot if he masters the principles of strategy and tactics in the air, will more readily develop into a successful fighting pilot than another. The work which a man excels at is decided in a certain measure by his inclinations. Some airmen are ambitious to fly well and to fly artistically. They desire above all things to gain proficiency not for competition purposes, but simply because they are naturally attracted towards perfection. Others exhibit no abstract interest in perfection, but simply desire to excel over their fellows. This competitive instinct is undoubtedly necessary to one who desires to become a very successful fighting pilot.

During a battle in the air, accurate flying is a great advantage, but too great concern in the details of controlling an aeroplane might be a disadvantage. It is therefore found that some brilliant trick flyers have proved but poor fighting pilots. They have concentrated too much attention on the act of flying to spare enough for mastering the opponent.

And perfect flying, as it is now understood, is in many ways unsuitable for tactical purposes, although the practice of it forms a valuable training for tactical manœuvring. It may, in fact, be said that while good flying is a very great advantage in aerial battle, too much concern for good flying is a disadvantage.

The chief need, in aerial combat, is the ability to manœuvre quickly without loss of height. If, in an

Digitized by Google

attempt to turn as rapidly as possible, a machine flying near its ceiling is handled roughly, two things will happen. The machine will *not* turn as quickly as possible and speed and height will be lost. Therefore, rough handling must be avoided and the mistaken notion that violent movements of the aeroplane controls beget violent movements in the aeroplane must be discarded. The quickest turn is initiated by a very gentle movement of the stick; but immediately after the initiation the stick movement is accelerated. Movements of stick and rudder must be nicely co-ordinated according to the "feel" of the pilot.

All the finer points of flying are discovered by experience if the pilot forces himself to be perpetually on the watch for them. This value of experience should never be overlooked in training fighting pilots. The more they have been in the air the more likely will they be to act rightly in the face of the enemy. It is impossible to live in the air as men live at sea, and therefore it is of double importance that the higher command should appreciate the value of air experience and should see that pilots and observers not only spend a great part of their time in the air, but that they also are encouraged to interest themselves in aircraft on the ground. Experience may be gained by discussion as well as by practical experiment. "Experience," says Admiral Sir Reginald Bacon, in his book, The Dover Patrol, "is a thing so subtle and unobtrusive that it is often little appreciated by those who have the ruling of affairs, yet it is the paramount factor in planning all operations."

Like playing a musical instrument, flying an aeroplane can be learnt only by long and intelligent practice. A certain period every day should be devoted to one manœuvre, and all manœuvres should be taken in turn and studied both in theory and in practice. Talking "shop" on the ground is a valuable form of auxiliary training. When a fair mastery of every aerial manœuvre, executed with and without engine,

Digitized by Google

has been acquired, the course of action to be pursued in the event of engine failure at any moment during the manœuvre should be decided and practised.

Squadron and Wing Commanders should note that a good means of ascertaining the relative proficiency of pilots is for them to be made to execute a turn as rapidly as possible over a camera obscura. Their course is plotted on the table in the camera obscura and the time taken is noted. By this means also a pilot may resolve his doubts as to the efficacy of a certain method of executing a manœuvre.

Technical knowledge is a definite assistance to flying skill, and the better a pilot understands the construction and working principles of machine and engine the better pilot he will be. Admittedly there have been pilots of slightly above the average flying ability who have been completely ignorant of the technical side of their art. But such pilots are rare, and always the best ones possess a very clear understanding of their machines and engines.

And now a few remarks may be made upon the psychological side of air warfare.

In all fighting a preliminary moral victory is half the battle. The first view of the enemy has a very great effect, and the first stroke, although it may not in itself be decisive, often has an overwhelming effect in determining the result of the conflict. This preliminary effect is apparent only after the first shock of close conflict; it does not of course apply to the strategical action.

It happened on occasions during the War that, when one machine was approaching another on the level with the purpose of attacking it, the quarry turned quickly and went straight towards its opponent. Frequently the result of this sudden determined show of fight was that the tables were turned and the attacker became the defender. Yet all this could occur before a single shot was fired! Sir Toby's

Digitized by Google

advice to that excellent coward, Sir Andrew Aguecheek should be taken note of by every fighting pilot. "So soon as thou seest him draw," he says, "and, as thou drawest, swear horrible; for it comes to pass oft that a terrible oath, with a swaggering accent smartly twanged off, gives manhood more approbation than ever proof itself would have earned him." It is so in the air. The pilot who, the instant the machines are at close quarters, shows fight in a direct and determined manner has gone far to win although he may not have fired a shot.

The converse is true. To run away, except in order to effect a desirable change of strategical position, is to court disaster. This danger of showing the least sign of weakness or vacillation requires much reiteration in order to ensure that a pilot shall avoid it. For, though he may be a brave man, an aerial attack sometimes comes with so startling a suddenness that he has no time to think or to consider; the promptings of nature sometimes urge flight, and, before he can reason, he has listened to those promptings. The result is that, when he decides to turn to the attack his opponent possesses that intangible something which carries so overwhelming a weight in battle and which is called moral superiority.

"La supériorité dans notre arme," says Fonck, "est une affaire de moral. Il faut, pour prendre sur l'ennemi un véritable ascendant, posséder sur des appareils à peu près equivalents, l'équilibre parfait de l'esprit qui fourni les moyens de le dominer." Exactly how airmen may be trained to dominate an enemy morally is difficult to decide. It is almost impossible to bring definite proof of the efficacy of any system of training. Undoubtedly, however, moral domination is a function of the individual and has nothing to do with discipline. You cannot train a man by discipline to gain moral ascendancy over his enemy. On the contrary, discipline, whose object is the sub-

Digitized by Google

jection of the individual, may have a bad effect upon the moral of the fighting pilot.

Sport may assist in this moral training, but it is doubtful if it does so. Knowledge is probably the greatest asset. The pilot who is conscious of a deep understanding of aerial fighting and who is confident of his flying prowess is likely morally to dominate his opponent regardless of the way in which the chances of battle point. The pilot may again be compared with the musician. The musician who, by intense labour, has improved his technique until he has satisfied himself that he has learnt everything he is capable of learning about his instrument, dominates his audience the moment he steps on to the concert platform. "He has a strong personality." That is the explanation usually given for this domination exercised by a musician apart from his actual playing. But personality is a word which has not been explained. It is more likely that the musician's moral superiority to his audience is the offspring of his consciousness of his own mastery.

Let the training of the fighting pilot, then, be carried out with the sole aim of giving him absolute mastery of his subject. Let him be encouraged to explore every field of theoretical and practical endeavour until he is positive that he not only knows, but is on terms of the closest intimacy with, the whole ground. It is a long task requiring many years of work; but it is a task which possesses a fascination basically similar to that of the arts and almost as powerful.

Digitized by Google

CHAPTER XX

CONCLUSION

A THOROUGH knowledge of the strategy and tactics of air-fighting assists an air force in attaining air supremacy. In war complete air supremacy is victory. A nation possessing complete air supremacy has put out the eyes of its opponent; it is fighting a blind man. But not only is it fighting a blind man, for air supremacy reaches further than the prosecution and prevention of observation, it also maims the opponent and stifles his will to fight.

The heart of a nation at war is the towns and villages, perhaps far from the fields of battle, where live and work the civilian population; where supplies are gathered and sent to the army; whence comes the moral driving force which alone can support and encourage the fighters. The aeroplane can reach these towns and villages and it can spread destruction and terror until the will to fight is broken among the civilian population; and then there is but a moment before the paralysis spreads along the limbs to the armies at the front. According to Captain René Fonck 500 aeroplanes could destroy a town 1 km. square in a night, and a town like Paris in two or three weeks.

That bombing branch alone of the aerial arm possesses tremendous striking power; a power which is but faintly imagined even by those who experienced what may be called the preliminary experimental bombing of the last war. The devastating effect of frequent heavy attacks by gas and high-explosive bombs will be made full use of for the first time in the

Digitized by Google

next war. And the rules of the Hague Commission will not prevent those attacks from being directed against the civilian populations; for the nations which start wars are not commonly worried by scruples as to the propriety of their subsequent actions.

It is ridiculous to expect those who will wilfully plunge millions into bloodshed to make nice distinctions between fair and foul. Can the wildest pacifist really believe that women and children would be safe from the reeking hands of those to whom murder is an entertainment should they be against us? And it is from such quarters that danger should be expected and anticipated, not from the more sane and decent peoples.

The march of civilization, as the world regards it, as it caused the last war to be the worst that has ever been fought, will assuredly make the next war a hundredfold more terrible.

Air attack must be looked for against the civilian population and methods must be evolved to meet it effectively. But attack on the civilian population is but one phase of aerial warfare. Another phase is the bombing of troops both in the lines (if the war were fought on land, as part of it must be) and in the rest camps. In the bombing of troops the moral damage is more serious than the physical damage. The physical damage on troops in trenches and dug-outs is almost negligible; but the moral damage is exceedingly great. If troops can be prevented from sleeping when they have time to do so they will clearly be more readily overcome in battle, for they will be without opportunity for moral or physical recuperation.

Again troops may be attacked by machine gun fire from low altitudes. This means of attack is also very damaging to moral. The carefully planned trenches, the sentries and so on are all swept aside, as it were, and the men exposed, almost helpless, to the aeroplane machine guns.

Digitized by Google

Air attack can also be very effective against stores. When a certain pilot was flying a new machine across the channel one day in 1916 he noticed a heavy layer of smoke in the sky at an altitude of about 5,000 ft. As he approached nearer to France the smoke grew heavier until it resembled a thunder cloud. From Cape Gris-Nez the cloud stretched away due east and instead of flying direct to St. Omer, he changed his course out of curiosity and flew along under the smoke cloud which descended closer and closer to the ground.

He was then approaching one of the war secrets that never leaked out beyond the services, although that flag of smoke proclaimed it right across the channel. For on that morning, at about four o'clock, the huge ammunition dump at Audruicq was bombed from German aeroplanes and set on fire.

That is what bombing can do to war material. And that was bombing with imperfect bombs and imperfect bomb sights. Air supremacy is vital to the civilian population; to troops and to material. All must be protected from air attack for, upon all, air attack can work havoc. The briefest examination of the powers possessed by aircraft shows that air supremacy in both attack and defence is not simply an assistance in prosecuting a war, but is an essential. If the crude aeroplanes of 1914-1918 could worry troops and civilians and could destroy material, what will the aeroplanes of the future be able to do?

If we admit the power of the aeroplane in offence, we must next enquire into the position of England for purposes of defence against air attack.

The natural defence of the sea is not negatived by the conquest of the air, but its protective value is diminished. I will recall the aeroplane raids on London. With the most elaborate anti-aircraft system that has ever been evolved in operation, the Gothas came and went suffering small loss. But the Gothas carried in petrol and oil more weight than they carried in bombs. Therefore their bombs were

Digitized by Google

necessarily small and ineffective. Already developments are in progress which, by the use of gears between aero-engine and airscrew, by the use of variable pitch airscrews, by engine super-charging, by the use of stratified charges, and by variable stroke devices like the Damblanc, will permit longer distances to be flown with smaller engines and much less fuel. In other words, England will be within range from a greater distance, of bombs much larger than any that have yet been used against her. And this is entirely apart from the natural development in the intrinsic efficiency of the aircraft, engines and bombs.

Britain is a far-flung Empire, and therefore the arm which possesses long striking range is a menace to it. For any enemy or combination of enemies a moment's study of the map will show Britain's vulnerability. Air supremacy, absolute and unchallenged, is the only possible safeguard for Britain.

And that leads to the question: did we possess air supremacy in the last war?

The answer to that question is No. At the end of the war with a preponderance of machines we possessed air superiority, but by no means air supremacy.

The methods and powers of attack by aircraft have been pointed out; they may be recapitulated as follows: Observation, attacks on troops, attacks on material, attacks on civilian population.

Towards the end of the war our aeroplanes admittedly effected nearly all the observation that was required. Gun-ranging, photography and reconnaisance were carried out consistently and well. But they were also carried out by the enemy, so that the effect of one virtually balanced the other. There were few parts of the line where, on a clear day, an enemy balloon could not be seen. Often a single reconnaisance machine would come over our lines—at a great height it is true, but no doubt with a good camera. Gun-ranging by the enemy was disturbed

Digitized by Google

by our aeroplanes, but not stopped. We observed; but so did the enemy.

So much may be said for observation. Attacks on troops by machine gun fire were carried out extensively by both sides, as were attacks on material and attacks on the civilian population.

Now true air supremacy could have reduced observation and offence by enemy aircraft to an inconsiderable minimum. No enemy balloon would have been allowed up; no machine would have crossed the lines and got back again; no gun-ranging by enemy aircraft would have been permitted, and even night bombing would have been checked.

It may be argued that such absolute supremacy is impossible of attainment; but there is no vestige of evidence with which to support such an argument. On the contrary, there is every reason for believing that, given the right machines and the right men, such an absolute air supremacy would have been attainable. And, as already has been indicated, complete air supremacy blinds the enemy, breaks down his resolution and maims him; while preserving friendly forces unharassed and, as far as air attack is concerned, almost unharmed.

Air supremacy is victory. And what is more it is victory with less bloodshed than when the ground forces have to wage a long drawn out warfare while an equally long drawn out warfare is being waged in the air. Capitaine Fonck, in *"L'Aviation et la Sécurité Française,"* lays stress on the value of an air force as an instrument of economic defence.

An army, A, is easy prey to an army, B, numerically much inferior but possessing full information of A's movements and having its guns ranged from air observation against A's guns ranged by ground observation. A may be surprised at any moment. B cannot be surprised, but can effect surprise. The strength of the ground forces is not so important as the strength of the air forces. If the air force

Digitized by Google

promptly clears the air and proceeds unchecked in its own business of observation and offence, the ground force is required to attack an army already half defeated.

The ground forces may pour in torrents against the enemy, like rain on the roof, but they do not flood the house until the wind has first blown the roof off and laid bare the rooms. The air force is the wind, and when once it has done its work the flood follows inevitably, and the occupants must run for their lives.

It has been necessary to point out what air supremacy could do as a corrective to the popular assumption that the allies possessed complete air supremacy in the last war. It has also been necessary to point out what air supremacy could do, in the hope that when once its value is understood Britain may be fired to attain to that supremacy. There would be no more war so long as the supremacy was absolute and unchallengeable, and so long as it was possessed by a nation which understands the meaning of power.

At present the Americans are planning great strides in air development, and it seems that they will gain a certain air superiority unless Britain awakes and discovers the truth. Not that the Americans are to be suspected of evil designs, but air power, which is synonymous with world power, is a thing that should be handled only by those who are accustomed to handling loaded firearms. If it were stolen by those unused to its mechanism they might not know it was loaded. Britain still possesses the means of regaining air superiority, and a very brief indication of how this may be done will be given.

Air matters are not understood readily by the general public, for they present some unique problems, and at present there is not the spread of knowledge consequent upon extensive amateur flying. The problems of shipping are faintly appreciated by all those multitudes who have voyaged upon the

Digitized by Google

sea, and the problems of road transport are well understood by the majority of motorists. But flying is not practised except by the few, and there exists in the general public, in our rulers, and even in parts of the R.A.F., a complete lack of understanding of the most elementary facts about flight. This state of affairs has militated and is militating against obtaining the best results in machine design.

For example, it is not appreciated sufficiently that quality is more important than quantity in the air. If a thousand well-armed aeroplanes of pre-war design were matched against one modern single-seater fighter it is probable that the fighter would shoot down the thousand aeroplanes if its fuel and ammunition held out long enough. Anyhow, the thousand would be perfectly incapable of offensive action against the one if the one wished to avoid their attack. It therefore becomes clear that figures about the size of an air force have but little bearing upon its strength; they may be positively misleading. This lack of connection between numerical power and actual power has led to many mistakes being made, especially in Parliament, where members without specialized knowledge have imagined that they know something about the strength of an air force when they know only its size.

This is not the place for comments upon our air force policy, at the same time it must be said that no one can have any conception of the needs of the air force who has not an understanding of at least the broad principles governing the strategy and tactics of air fighting.

There is every reason to believe that in this country we possess men who can fly as well as any in the world. There is also reason to believe that we possess designers who can produce machines actually better than any others in the world.

It remains for us to make use of our talent and to achieve a complete and overwhelming air supremacy.

Digitized by Google

If we really do not want another war we can easily prevent one from occurring. If we believe in our own integrity there can be no harm in possessing air supremacy. A balance of powers is a potent irritant which must lead to war. Two evenly matched schoolboys are never satisfied until they have had a trial of strength, whatever form it may take. It is a natural yearning. But if, when the trial takes place, one proves beyond any doubt that he is the master, peace thenceforward will reign between them. I am not venturing to compare the rulers of the destinies of nations to schoolboys; but natural impulses rest the same in schoolboys as in nations, and it is those natural impulses that cause wild policies to be pursued even as far as the ultimate test.

Digitized by Google

APPENDIX

AIR FIGHTING IN THE FUTURE

THE fighting aircraft of the future and the methods they will employ in combat provide much interesting matter for speculation. Such speculation leads us among strange wonders and, if the period considered be very far ahead, the reason checks at what the imagination conjures up. Conjecture therefore will herein be confined to those developments which are clearly adumbrated by the most advanced aeronautical research work of the present day and the imagination will be restrained. Even so the most modestly painted picture of air fighting in the future proves dazzling.

First, I believe that the two main groups of aircraft will be retained for their special purposes. The big multi-engined machines will attack ground targets and the very small machines will specialize in fighting other aircraft. Between these two extremes, however, there will be many other specialized types and the existing many-purpose aeroplane, which is intended equally for, say, photography and artillery observation, will disappear. Instead, for each kind of air work a highly specialized type of craft will be produced.

And one of these specialized types will bring a new terror to the cities which it attacks. If there were another big war the inhabitants of cities would be subjected to the horror of being shelled from the air.

Medium-sized aeroplanes, each carrying a single big gun and possessing a better performance than a bomber, will form part of every raiding formation.

Digitized by Google

Then, while the bombs are screaming earthwards, these brigades of aerial artillery will sweep down to a few feet above the chimney pots.

The aerial gunners will train their special sights on some predetermined objective, such as a railway station or a centre of government, and will hail shells upon it with deadly accuracy. A salvo from a formation of one hundred aerial big guns would flatten out buildings like the Houses of Parliament as a steam roller would flatten out a sand castle.

The aerial artillery machines, which will probably be three-engined biplanes, will not carry many shells. They will attack only one or two objectives on each raid. The value of their attacks will lie, not in the weight of explosives they distribute, but in the extreme accuracy of their attack. Weight—for this special purpose—will be sacrificed to accuracy.

When a large formation of aerial artillery attacks a railway station, an ammunition dump or an arsenal, *that station, dump or arsenal will be obliterated.* The only protection against this form of attack will be afforded by the single-seater fighters who must scatter and turn the formations of aerial artillery before they can reach their objective.

Balloon barrages will not provide adequate protection, for the machines would probably approach their target high and dive down at the last moment.

It has been known for a long time that the bomb, even with the best sights and under the best conditions, is grossly inaccurate. It can hit a town from 10,000 feet—if the town is big enough. If, to gain accuracy, the bombers fly very low the velocity of the bomb and therefore—for certain targets—its effect, is reduced. Moreover, a big bomber formation, slow and sluggish on the controls, could not, with the requisite degree of safety, fly low over a defended town far over enemy territory.

Now nothing in modern research work gives indication that there will be a notable gain in the accuracy

Digitized by Google

of bombing from great heights. So either nations at war will be content with the very haphazard bombing as it is now carried out, or they will evolve a new means of attacking ground targets.

The arrival of the aerial big gun has been foreshadowed in all countries. In this country the Davis gun and the C.O.W. gun were early attempts to increase the hitting power and accuracy of fire from aircraft. Therefore the arrival of the aerial big gun for use in low-altitude attacks on ground targets may confidently be predicted.

The extreme accuracy of the aerial big gun will make it an excellent weapon for attacking ships. In addition, its moral effect will be almost inconceivably great. Low-flying machine-gun attacks always have proved demoralizing to troops, but a formation of aerial artillery diving to the attack will be a thousandfold more effective.

The problem of the type of big gun and its mounting need not be entered into here. The recoil may be absorbed on the principle of the Davis gun or the C.O.W. gun, or on some entirely new system. Such technical difficulties will not be insuperable.

But the aerial big gun—contrary to the expectations of some people—will not be used against other aircraft. It will be used only against ground targets. And against the civilian populations of big cities it will prove immeasurably the most terrible weapon ever devised.

But although the aerial artillery machine will be more novel, the fighting aeroplane of the future will be infinitely more startling aerodynamically.

The fighting aeroplane of the future will be a very small all-steel monoplane mounting a 1,000 h.p. gas turbine engine and possibly incorporating some form of jet propulsor. It will be capable of 400 miles per hour on the level and will have a terminal velocity in the dive of nearly 800 m.p.h. In other words, it will be able to travel faster than sound.

Digitized by Google

It will climb to 20,000 feet in four minutes and its service ceiling (which is the height at which the rate of climb falls below 100 feet per minute) will be 60,000 feet. Everyone who, in 21 years, has watched the speed of aircraft mount from 30 miles per hour to nearly 300 miles per hour, and the height attained increase from 10 feet to nearly 40,000 feet, will agree that the figures given for the fighting machine of the future are more likely to prove under-estimates than over-estimates.

In order that the pilot may be able to fly at a height of ten miles from the ground, and in order that he may be able physically to withstand the sudden changes in pressure when diving and climbing steeply, he will be enclosed entirely in a pressure suit like a diving suit, but—obviously—lightly made. A desiccating apparatus would be required to prevent the goggles in this suit from "fogging up" in the dive.

The pilot will wear an automatic, free parachute, similar to the Holt which is operated by a timing apparatus.

(Looking further ahead, I feel that the totally enclosed pressure cockpit, with some form of transparent, streamline conning-tower must eventually be incorporated in fighting aeroplanes. The difficulties of constructing such a cockpit are so immense, however, that it cannot be considered here.)

The fewest possible accessories will be carried on these arrows of the upper air. They will have none of the bomb racks, flare tubes, signal pistols, landing lights, navigation lights, fire extinguishers and other odds and ends with which present machines are encumbered. They will not even carry wireless. They will consist in engine, aeroplane, man and gun.

The gun will be of *smaller* bore than the modern machine-gun. It will be a composite weapon consisting of several barrels and will have a terrific rate of fire.

Digitized by Google

It will eject bullets so rapidly that the effect will be a whip-lash of lead. This lash of lead, when it cracks across the wing of another aeroplane, will cut it like butter.

The fighters will rely, for tactical defence, on their speed, climb and manœuvre. Their power of manœuvre will be very high.

The question of whether the human frame can resist collapse when it is being flown round a corner at 300 miles per hour or more has been discussed by racing pilots and by doctors. An American doctor is reported to have said that the limit of human endurance had been reached and that it would be useless to build faster aeroplanes because their pilots would be unable to fly them at their maximum speed.

If the American doctor said that, he was wrong. The stresses on the pilot's body depend, of course, not only on the speed of the machine, but also on the radius of the turn. It is quite safe to say that we have only begun to learn the meaning of speed and that a method will be found—if it requires finding—by which the fastest fighters will be enabled to manœuvre freely at their maximum speeds.

These fighters, indeed, will rely primarily upon their speed, climb and manœuvre for success when they engage in battle with other machines. And upon these high-performance fighters will depend all other air work, such as photography, bombing and shelling of ground targets, co-operation with the navy and army, reconnaisance and artillery observation. The fighters will clear the way and keep it clear for the other types of craft. The preliminary to all air operations will be a furious struggle for mastery between the opposing fighters.

There will also be long-range fighters which will escort the ground-attack formations on their raids. These machines may be two-seaters and they will, of necessity, be far less swift and less vicious than the specialized fighters.

Digitized by Google

In the aerial battle itself the same strategy and tactics which have been described in this treatise will be employed, for as it has been shown, the basic principles which have been laid down are not susceptible to alteration.

A day attack on a great city would be carried out by an enormous layer formation. The top layer would be long-distance fighters, the next layer huge monoplane bombers with four or six engines built into the wings, the next lower layer would be more long-distance fighters, and lowest of all would be the aerial artillery. All the machines would carry the special "whip-lash" guns already described.

This towering castle would approach its objective at about 170 miles per hour. Anti-aircraft fire might account for one or two of the machines, but the only chance of the attack being definitely warded off would come from the defending fighters, the arrows of the upper air. Having scaled to the freezing, stone-hard blue of the great altitudes at the first alarm, these fighters would be awaiting their opportunity.

And when the moment came the fighters—in a loosely-knit formation grouped in threes—would plunge to the attack in one breathless drop.

There would be a yell from many whip-lash guns, and the fighters would sweep vertically upwards again in preparation for the next stoop.

Finally, with many losses on both sides, with the enemy formation breaking up, with machines straggling, others falling out of control or in flames and with crews floating down by parachute, the fighters, acting in accordance with tried tactical principles, would go in and stay in until they had turned the enemy.

In groups of three they would wheel and dive, flicking from bank to bank like swallows in fierce gusts of wind, while tracer bullets would scratch a multitude of angry furrows on the sky. If they possessed adequate speed, climb and manœuvre the

Digitized by Google

fighters would disorganize and finally turn the raiders.

But if, on the other hand, the defending fighters were technically inferior, the enemy formation would fly straight to its work. It would not heed the ineffectual pecks of low-performance machines.

A battle between formations of fighters would be fought exactly as described in this treatise, but everything would happen more quickly than it would happen at present. In fact, the chief characteristic of fighting in the air in the future will be its dazzling rapidity.

I do not believe that wireless-controlled aircraft will play a very big part in any future war. Their defencelessness is likely to prove a severe handicap. Airships will be forced to keep far from the chief scenes of operations.

Armoured aeroplanes will not make their appearance, save for low-flying attacks on ground targets, for several decades. Shields for the aerial gunners of big machines will, however, be fitted in the near future.

BRISTOL: BURLEIGH LTD., AT THE BURLEIGH PRESS.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

UNIVERSITY OF CALIFORNIA LIBRARY
BERKELEY

Return to desk from which borrowed.
This book is DUE on the last date stamped below.

5NJan'52FA
DEC 8 1952 LU

14Oct'53CW
OCT 12 1953 LU

4Apr'54MC
MAR 23 1954 LU

MAY 3 1954 LU

26Nov54KWX

7May'54PW
MAY 8 1954 LU

26Nov54KWX

NOV 12 1954 LU

27Apr'55MC

15Jun'55PL
JUN 1 1955 LU

26Aug'57MF

REC'D LD
AUG 26 1957

26Apr'59DF
REC'D LD
APR 26 1959

9Nov'59EJ
REC'D LD
NOV 12 1959

12May'60RS

REC'D LD
MAY 23 1963

LD 21–100m-7,'52(A2528s16)476

Digitized by Google